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Winding Drum Armatures.

BY WM. BAXTER, JR.

The means ordinarily employed for winding drum armatures are not only unhandy, but of such a character that only an expert winder can produce good work with them. Notwithstanding this fact, they are in use by the great majority of manufacturers, as well as those who confine themselves to rewinding armatures of the machines they are using. What the means look like can readily be seen from Fig. 1. They consist of a pair of uprights, provided with grooves in the top for holding the armature shaft, and a convenient bench upon which to locate a spool of wire. In some cases, where an attempt is made to have more perfect apparatus, the uprights are replaced by a small lathe, in which the armature can be held between centers, or with one end in a chuck and the other upon a center. In either case, the principle of operation is the same. If the armature is very small, and is wound with wire not larger than, say, No. 12, one man can do the winding; but if it is of any size, or if the wire is thick, even if the armature is of small dimensions, two men will be required. The winder stands in front of the armature, and the helper between it and the bench upon which the wire spool is held. When the armature is in the position shown in the figure, the winder places the wire in the proper position on the side of the core away from him, and then revolves the armature through one-half of a turn. In the meantime the helper takes hold of the wire at a point between the armature and the spool and, drawing out a sufficient amount of slack, passes it to the other end of the core. As it is necessary that the wire should lay in place without kinks, and with a sufficient tension to prevent it from becoming slack, the helper must hold it tight, and at the same time be careful not to take hold of it at a point that would come upon the surface of the armature, for if he did, there would be a kink at that point that would be difficult to straighten out. If the bend put into the wire by the hand of the helper comes at the part that lays on the end of the armature, the effect will not be so bad as it is necessary to bend the wire back and forth considerably by this process to fit it into its proper place over the ends.

The helper cannot confine himself entirely to guiding the wire, because, occasionally, either he or the winder will get his arms so tangled up that he can go no further without releasing his hold, which would not be permissible. In such emergencies the one who has a disengaged hand comes to the assistance of the other and helps him to hold his part while he gets the twist out of his arms.

The objections to this method are, that a uniform tension cannot be maintained upon the wire, that an unnecessary amount of bending must be done, and that even with the greatest of care, either the armature or the wire is apt to slip away from the winder or the helper, and thus allow several turns of wire to slack up. This slack can be taken out, but the

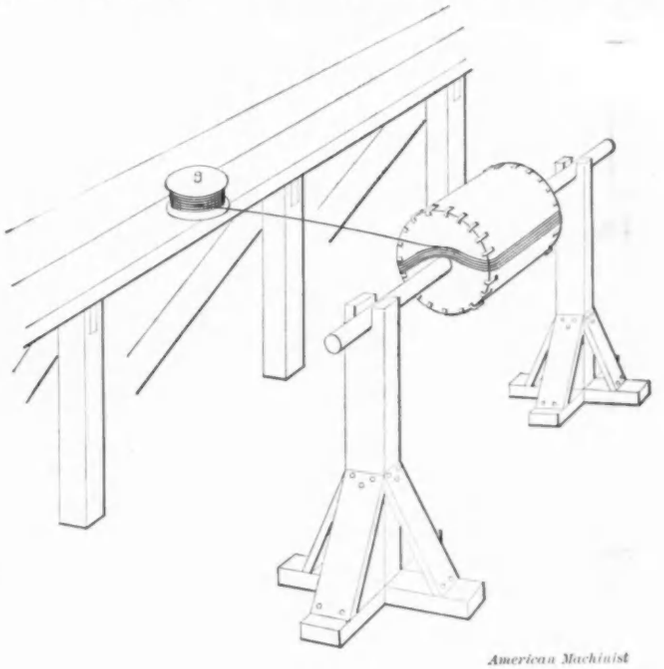

Fig. 1
WINDING ARMATURES, COMMON METHOD.

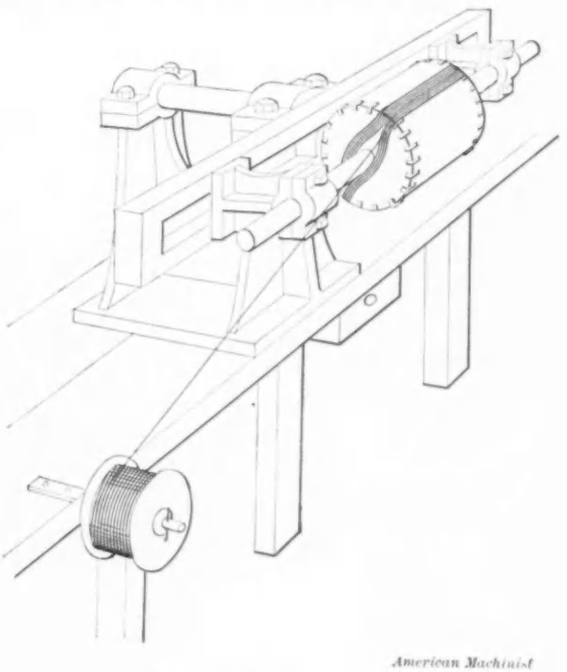

Fig. 4
WINDING ARMATURES, IMPROVED METHOD.

original snugness can never be restored. For these reasons the work cannot be made as perfect as it might be. Another objection, which to the manufacturer is the greatest of all, is that the cost of doing the work is greater than when more perfect means are employed.

Some twelve years ago the writer began the manufacture of motors in which a drum armature was used, and realizing the defects of the method described in the foregoing, designed the apparatus shown in Figs. 2 and 4. From the latter figure it will be seen that the armature is held in a frame that is mounted upon the end of a shaft. The axis of this shaft being at right angles to that of the armature, its rotation swings the armature end over end. The wire spool is placed upon the bench at a distance of 5 or 6 feet, and the proper amount of tension is obtained

Fig. 3

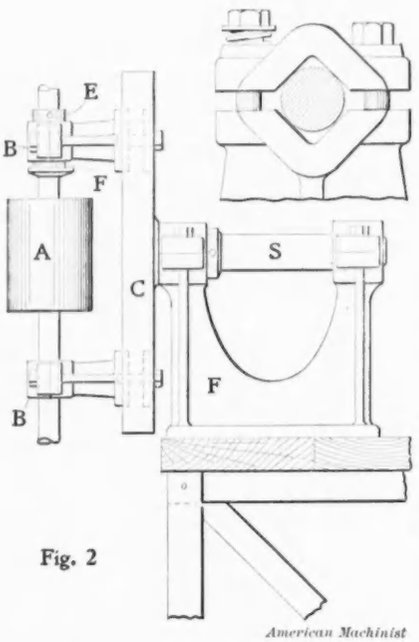

Fig. 2

DETAILS OF APPARATUS.

by means of a spring which presses against the back of the spool, the tension of this spring being adjustable by means of a screw. In order that the apparatus may work well, it is necessary that the friction of the bearings of the armature shaft, as well as the main shaft be greater than the tension on the wire can overcome, if not the latter would pull the armature back, and loosen the wire to some extent. So, to be able to graduate this friction, the caps of the bearings are provided with a spring under one bolt, as shown in Fig. 3. By making the bearings *B* of the armature square, as shown in Fig. 3, different sizes of shafts can be held without using reducing bushings.

The advantages of this machine are, that the wire is always held under an even tension; that it cannot become loose except by undue carelessness; that the wire is always straight until it passes onto the armature core, and, finally, that one man can wind an armature with it and do the work in about one-half the time required by the ordinary method. If the armature is of enormous proportions, it may require two men, one to wind and the other to help turn the armature over end for end; but if the machine is well made so as to be easy running, and the armature is set so as to be well balanced, it is perfectly feasible for one man to wind an armature 16 or 18 inches in diameter.

From Fig. 2 it can be seen that the machine can be adjusted within wide limits. The stands *B B* can be run out to the ends of the frame *C*, for a long armature, and they can be brought to within about one-half the distance for small armatures.

To retain the armature in position, endwise, a collar *E* is used, and if the wire space on the armature terminates in a polished brass head, a collar *F*, made of wood or some soft material, is inserted between it and the bearing to avoid scratching the surface of the brass head.

The knack of using the machine is easily acquired; the only point that is apt to trouble a beginner is the catching of the wire on the bearings that hold the armature shaft, when the latter is turned end for end. As can be readily seen, if the armature is revolved so far that the wire comes directly on top, it will be struck by the bearing as soon as the latter is rotated to about the position shown in the figure; but if the armature is set in such a position that the wire is not directly on top, but about as shown, the wire will pass by the side of the bearing. As soon as the bearing has passed above the wire, the armature is rotated far enough to allow the wire to drop naturally into the proper place. After a little practice has been had, it is remarkable to see how fast the winding can be done.

A cheap temporary apparatus on this principle can be easily constructed by making the frame *C*, as well as *F*, of wood; using a piece of pipe for the shaft *S*. Such an apparatus would answer well for small armatures.

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The Place of our Destination—V.

Editor American Machinist:

London, the center of a good many of the actualities of life, as well as the center of the world itself, is a center from which it is easy to reach out and see many of the desirable sights of England; and besides, it has within its own borders buildings ancient and historical side by side with the modern—Westminster Abbey, an old cathedral, and Westminster Hall, which for two or three hundred years was the largest hall in existence, side by side with the New Parliament Buildings; Staples Inn, a quaint old building in the midst of the rush of Holborn, a main thoroughfare; the Tower of London, once a palace, then a prison, and now a museum of war; besides, if one be a Dickens reader, many of the places he has rendered immortal in words, are still accessible in fact.

So long as the Newcastle coal mines exist, London is likely to remain a dingy-looking city. There are thousands of fine buildings, and hundreds of magnificent ones, architecturally; but usually before they are finished they begin to take on the London fog, and modern architectural embellishment is so nearly wasted genius, and wasted money, that a machine designer would naturally want, under the conditions, to rub off the projections, round off the corners and trust to shape for effect. Confining the buildings to within a reasonable hight avoids the awful conglomeration we are subjected to; and the best streets, both in the mercantile and resident thoroughfares, are simply long blocks, in many cases repeated, when the stores or dwellings are all alike. I know the tend of the present day is to have each one's house a special design; but when there are seven hundred thousand houses, it would take a good many styles to go round.

The absence of telegraph poles in the streets, and of wires overhead, compensates for many of the objectionable features in the London streets—not that the wires are all underground, for there are many overhead; but they run over the buildings, which this uniform hight permits.

One attempting to describe London is sure to be disputed as to his statements, because he may live in or travel in a section that his critic never saw. One may stay for weeks in the north, and always be traveling up and down hill; in the east or west end, and never know there was a hill in London; live in one section and never know anything but the crooked streets, lanes and alleys, and live in another and never know but that the blocks were all as square as in Philadelphia. Of course, there is an enormous amount of manufacturing done here, such, for instance, as Crosse & Blackwell pickles, which can be bought in every grocery store in the civilized world, an immense establishment right in the heart of London; but in engineering or machine construction very little appears, except along the river banks—Brotherhood's Engine Works, Doulton's Pottery, Thornycroft's steamboats, etc. I expect if one has the cheek, or knows how to go about it, he could gain admission and find much of interest.

A trip up the river on one of the river boats is a pleasant ride, if one can spare the time, and gives a good idea of the extent of the city in that direction. Hampton Court, some eighteen miles or so, is an unused palace, at least so far as palace service is concerned, but in no sense a ruin, built by Cardinal Wolsey,

and, as the story goes, given to Henry VIII on his suggestion that it was too much of a palace for a Cardinal. It's an immense place, mostly picture gallery, in the midst of a great park. On the way up we passed Thames Ditton, where the Willans engine was developed, and on our way back, a drive of five or six miles through a country village, all the way over one of the good English roads which may have been 20 feet wide, with a 12-foot roadbed and sidewalk, and not in the whole distance an eighth of a mile straight. A stop at Richmond Park, which is a park on the hillside to the river bank at the bottom and rising to 150 or 200 feet above. Small as we imagine England to be, she has lots of room for beautiful parks, both in the city and out, and this Richmond Park has the merit of being in existence without crowding out anything else. To visit these two places makes a nice day's outing; another is to Kew Garden, where all known trees and flowers can be found, where many scientific investigations are carried on and the chronometers of the world are tested. One may easily find a dozen such day trips; and among those I had never tried before, we went to St. Albans, an old place where, centuries before, there had been a monastery, the buildings of which still stand, and an old cathedral, which, it is rather evident, was built by the Romans a thousand years ago, and is a wonderfully interesting structure. Geologically, London and the country round about is over a great basin, and the basin filled with a chalk formation, and the chalk is filled with nodules or lumps of flint. These lumps are pretty generally from the size of one's fist to his two fists. The ancients knew how to crack these flints in halves, and the fracture leaves a pretty flat face. The walls of the Cathedral of St. Albans, and the walls of other places, are faced with these flint stones set in mortar (or one would think it must have been cement to have stood these ages), and then every little way red bricks are laid in as binders. It is either from the shape of those bricks or their character that it is believed they were brought from Rome, and the cathedral built by the Romans. Feet and inches give no one who has not seen these wonderful old cathedrals any idea of their size and magnificence. I have seen probably twenty, and every new one becomes more and more a mystery to me, unless I accept what is now asserted, and may be true, that the architects of centuries ago were as much superior to the architects of to-day as were their buildings, and that their plans were made before the buildings were commenced, and the workmen followed the plans.

This cathedral building in the olden time might have been, and likely was, purely a religious move, but I believe, aside from that, that it was a grand, good thing to do. About the only thing our Government is doing that does not have to be done, that gives employment to working men, is the building of war ships and guns. This work requires skilled workmen largely, and when the work is done, it is not where the people can see it. On the other hand, take the cathedrals, and consider them as balance wheels to equalize labor. About the most of them, there is nothing but stone and labor; the stone all found in the neighborhood. They could always collect the dues for the Church as we collect taxes, always give labor work in dull times, and the money remained within their own circle. It made no difference when the cathedral was finished, and when they got through they had the cathedral and the money, too. I do not know as this simple consideration of the subject is in accordance with the Adam Smith school of political economists; but I wish our Government or different communities were building monuments that required only stone and labor, so as to give our unemployed work in dull times, rather than spend money in building implements of war to kill the unemployed off. Gun-making makes skilled artisans 'tis true. Cathedral-building made artists, and it may be as well to waste some material to make artists as to have too many artisans.

How many ever think of the commercial value of a cathedral or monument to a town? Anything that people go miles to see is of value. They pay to go and they get their money's worth or they would not go. Money every year comes from America to Europe by the millions, and for no other reason than because there is something to see.

Fast as we think we do things they in London come quite up to the mark also in some things, and one is in the extreme rapidity with which they replace an old building with a new one. In October, 1894, we attended a performance at the Olympia, a show place, I think, at least three miles from the center of the city. It was so large that it would seat in theatre style, except that they were in straight lines instead of in circles, some thousands of people. Between the audience and the stage there was a lake in which a dozen barges carrying some twenty people each sailed around, and the drop curtain of the stage was 150 or 200 feet long, and on the stage hundreds of people at once. The place did not seem large enough or grand enough to meet the demand of the times, so they determined to rebuild it. How long in advance the contract was let I do not know; but the last performance in the old building was about the middle of October, and that was demolisted and the new one ready for the initial performance on Boxing Day, which is the day, or in this case, the night after Christmas. Two months and a half all told, and the new building is of brick, with cut stone trimmings, at least 200 x 300 feet in size, with walls 30 or 40 feet high, and an arched iron roof. It was closed when we had spare time to attend, but I am told the drop curtain is 300 feet long.

JOHN E. SWEET.

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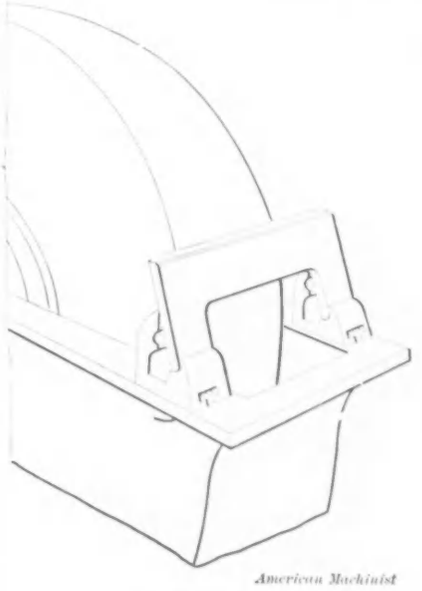
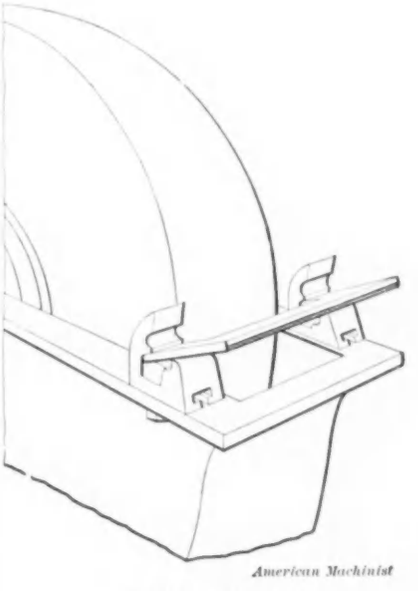
A Safety Grindstone Rest.

The grind stone rest shown herewith is referred to by "The Engineer," London, as "a safety rest, whereby danger to the operator is averted should the tool being ground become jagged by the stone." We cannot think that it makes accident



REST IN USE.



REST THROWN BACK.

impossible, but as a grindstone rest it seems to have some good points. It can not only be swung back, as shown in the second cut, but may of course be lifted entirely out of the way at any time, and it is easily adjusted to set close to the stone.

Designs for Steel Connections for Wood Frame Bicycle.

BY W. A. WARMAN.

Although never an enthusiast on the subject of wood frames, it recently fell to the lot of the writer to design a set of steel connections for a white ash frame. While at first candidly skeptical, I have, after careful study, and with the light which comes with the digging out of details, come to the conclusion that the wood frame has many points in which it is superior to steel. Wood frames will not buckle, kink, break or dent, while steel frames have all these vices. Considering the universally acknowledged superiority of wood for withstanding the wear and tear of the road in vehicles of every type, it would seem simply a matter of detail to adapt it to bicycle construction. One of the principal drawbacks to wood frames has heretofore been the clumsy-looking joints. This, I think, the sketch of the assembled frame will bear us out in saying, we have in a great measure overcome.

Rigidity of the joints being the prime factor in a frame, we have tried to obtain all possible symmetry without any sacrifice of staunchness. Fig. 1 in the details shows the head-lug, stamped from 16-gage sheet steel, and similar to the old original "split clip," except that the open side is longer and fish-mouthed. *A* is a ferrule tapered at both ends and brazed inside the clip. The object of the ferrule *A* is better shown in the sectional views, Fig. 3.

In assembling, the head-lug is brazed to the head tube, which is steel, and the ferrule *A* brazed in; the wood bar *B* is drilled for the threaded sleeves *E E*, to register with the screw holes *D D D D*, and the bar *B* is then drilled longitudinally for the projection on the malleable wedge *C*. The projection on the wedge is started into the hole in the bar *B*, the head is placed on the mandrel *G*, and the bar *B* driven to place, as shown in Fig. 3, expanding the wood into the ferrule *A*. This makes a joint exceedingly resistant to lateral strains. The clip is tightened down by the screws *D D D D*; this takes care of any transverse or torsional strains.

Fig. 2 shows one-half of the seat post connection. The joints are made in the same manner as indicated for the head connections. A 22-gage reinforcement is brazed into the body of the seat post connection, above the tapered ferrule, to allow about 2½ inches of saddle adjustment.

The crank bracket is made in three pieces, with a 20-gage reinforcement brazed into the main barrel; the joints to be secured in the same way as those previously described.

Fig. 5 shows one-half of the rear fork end, with the knurled nut and adjusting screw. This fork end we have made, in a slightly modified form, for steel frames. The adjusting screw is slabbed to a couple of thousandths thicker than the flat part of the fork end, thus allowing the cone and the axle nut to grip it when the wheel is adjusted.

The construction shown is for a straight-line frame; but as this is now considered by most makers a back number, I submit a sketch of a crank bracket designed for a steel frame, which could

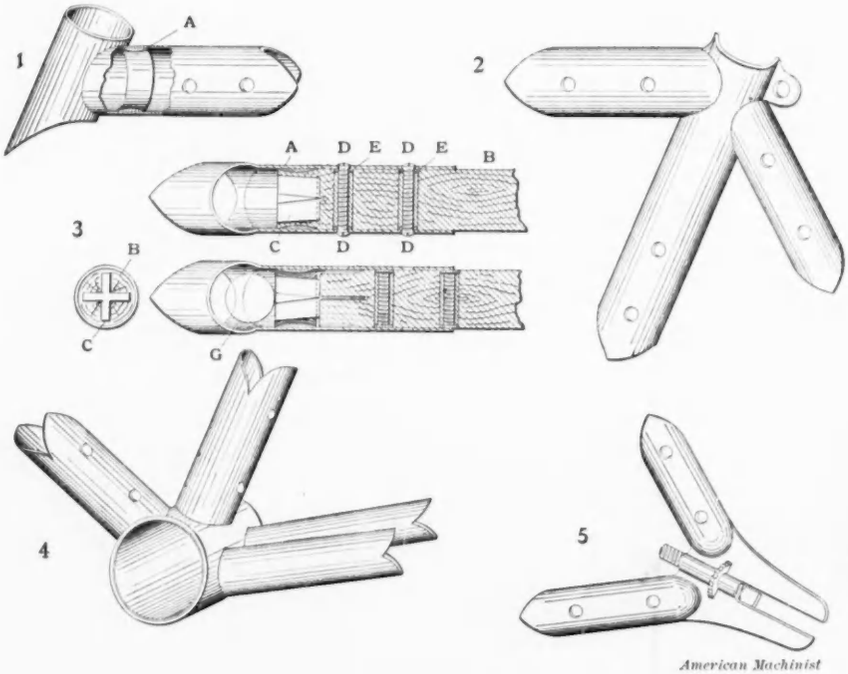
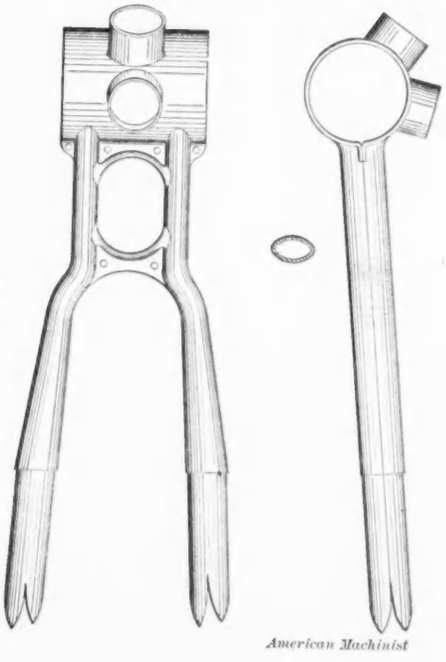


Fig. 7



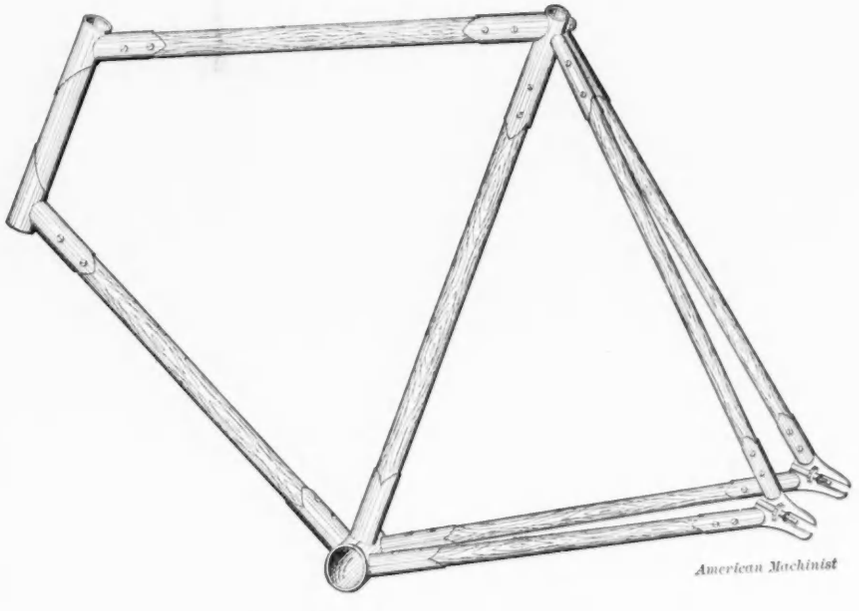


Fig. 6

be adapted to this construction. It contains the kinks which the all-wise agent explains to us as adding to the strength.

Last season an agent for a well-advertised wheel pointed out to me, with great pride, the two kinks in the oval section rear brace on the chain side, while one kink gave sufficient strength on the other side.

Surely the bicycle salesman's knowledge of things mechanical is something calculated to speedily cure any tendency to cranial elephantiasis in us poor worms with only a little practical knowledge.

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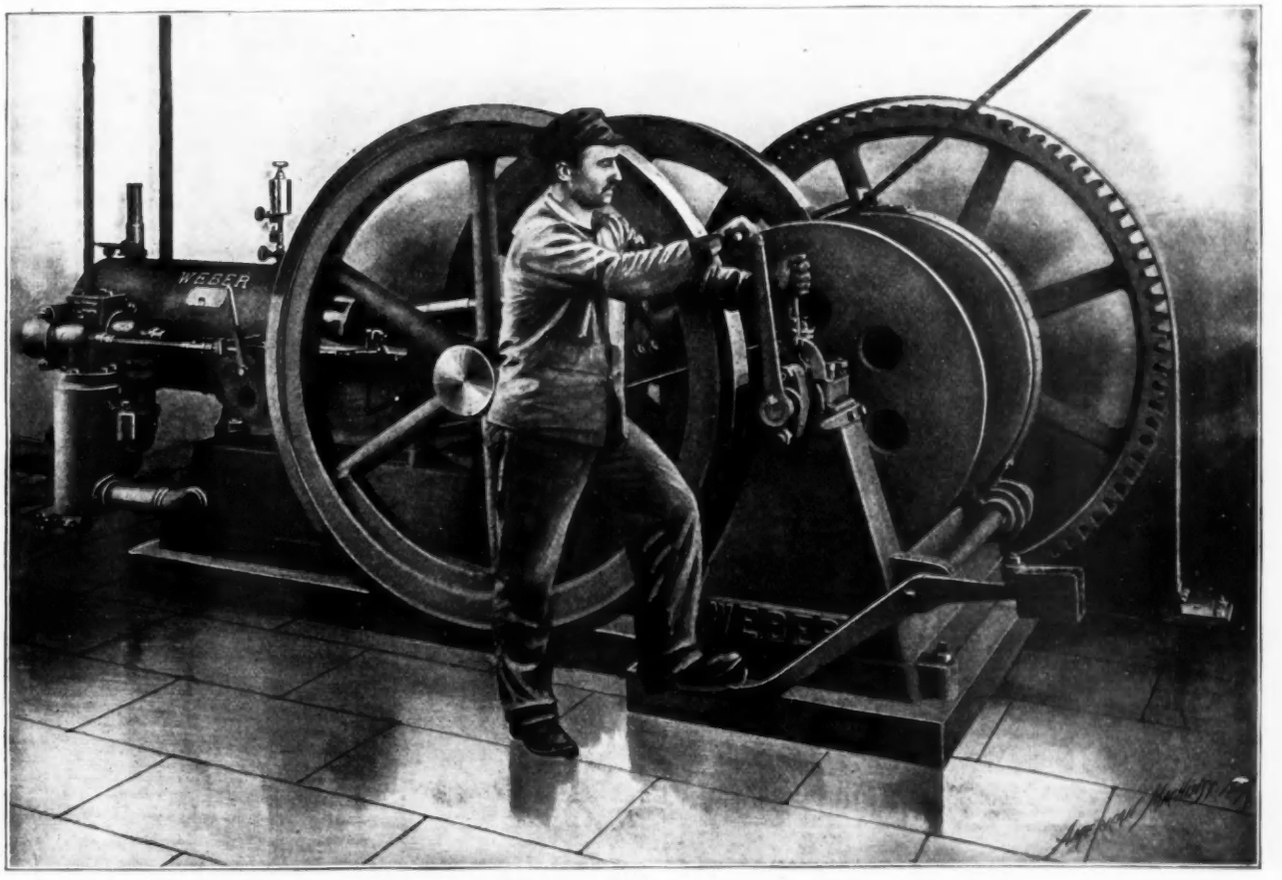
A Gasoline Hoisting Engine.

The Weber Gas and Gasoline Engine Company, Kansas City, Mo., are putting out an interesting line of gasoline hoisting engines, one of which, a 50 horse-power geared hoist, is shown in the half-tone herewith. The engine runs continuously, a small pinion on the engine shaft engaging with the large spur gear on the drum shaft. The drum shaft turns freely in the drum, a large internal conical friction surface, overhanging the end of the drum, engaging with a corresponding friction wheel keyed to the shaft. The long lever in the right hand of the operator works a large screw by which the friction is applied or released. This lever may be shifted around a quarter of a turn at a time as the friction surfaces wear. The foot lever controls the friction strap for lowering, and the left hand is free to manipulate a little lever by which the supply of gasoline is regulated according to the power required. The friction disk is filled with hard maple, which is, of course, renewable when necessary.

The machines are built in sizes from 6 to 50 horse-power, single and double drum, and with different ratios of gearing, according to the load or the hoisting speed desired. The gasoline consumption is only according to the work done. A 20 horse-power engine of this make, running as a stationary engine with full load, will use 20 gallons of gasoline in ten hours, while as a hoisting engine it would use only half the quantity, on account of the intermittent character of the work.



GASOLINE HOISTING ENGINE.

A Resident Traveler.

The Germans have invented a new sort of commercial traveller. He is new in two respects. In the first place he doesn't travel. In the second he doesn't work for his own firm; he works only for his customers. Some people might call him a shopkeeper. But he doesn't keep a shop. He keeps a sort of warehouse, or more properly a museum—in a foreign country, of course—and there he collects samples of all the things that people want, it doesn't matter who makes the things. They may be German, American, English, French, Italian—it doesn't matter. He will sell you anything you wish for, probably at a very much lower rate than anyone else. We hope his action will not be misconstrued. Some people might call him grasping. We prefer, however, to believe he does it out of the kindness of his heart. We can imagine—to be egoistic for once—that he says to himself, his dog, his pipe, his frau, as the case may be, "Ach! those poor English, he does not understand the commercial travelling, I will sit down quietly here and do it for him. Mein gott, is he not our relations?" It is really very good of him, and we feel persuaded that it will only more firmly weld the kind commercial chain which binds our mutual interests. Still, perhaps it would be better—more generous certainly—if Englishmen were to send their own travellers with catalogues in the right languages and measures, and suitable samples, and so save our German friends the trouble of doing these little things for us.—"The Engineer," London.

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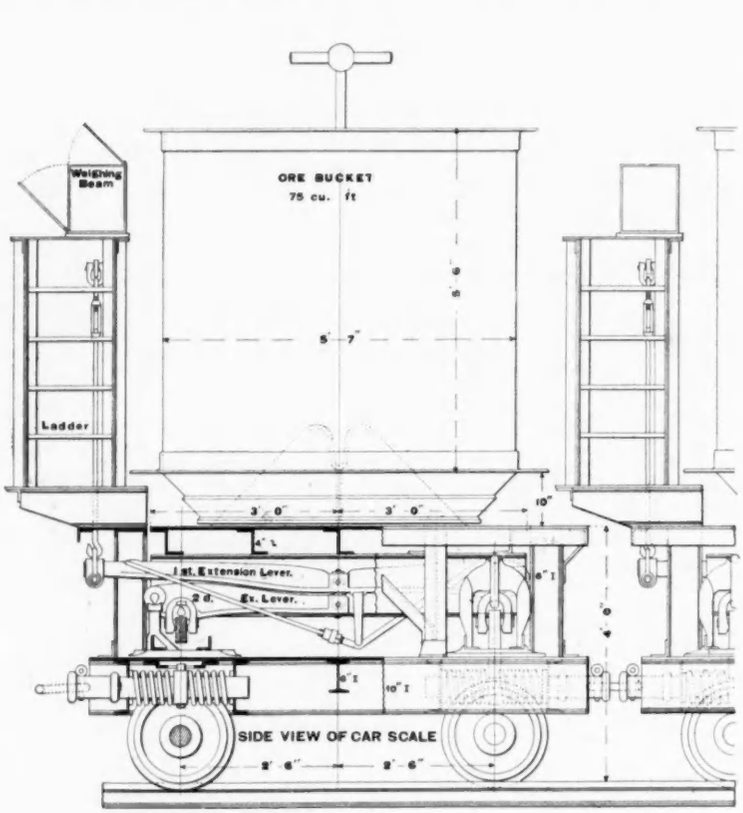
And now we have a whine about the dying out and probably the disappearance of the art of dyeing, for which the natives of India have been celebrated. The aniline dyes of Europe are killing their trade. It does not appear that the world will be the loser. The survival of the fittest inevitably means the ultimate extinction of the less fit.

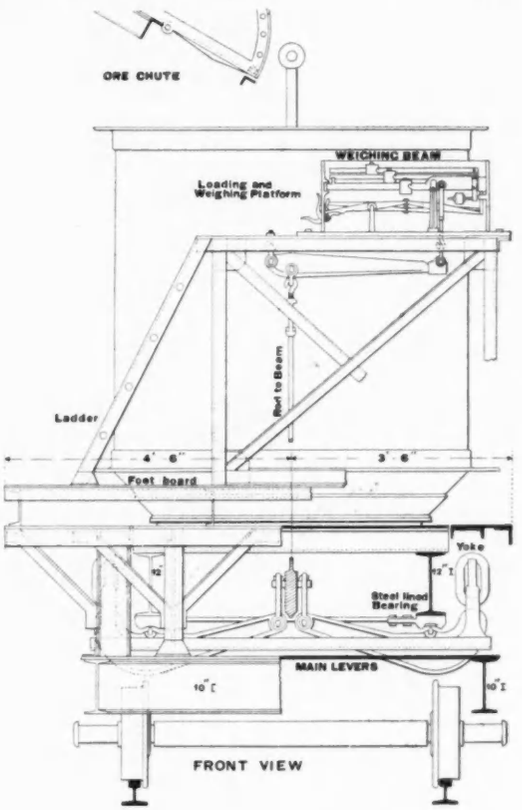
Special Car Scales.

BY W. H. SARGENT.

The accompanying illustration represents one car of a train of thirty-five, the scales for which have been built for the Carnegie Steel Company, at Duquesne, Pa., by E. & T. Fairbanks & Co., of St. Johnsbury, Vt. When it is remembered that coke, ore and limestone must be delivered in buckets at the tops of four furnaces, each 100 feet in hight, at the rate of 100 tons each hour of the day, it will be seen that the appliances must be of the most modern and convenient character. To avoid the delay of running the several loads on a scale to be weighed, it was decided to provide each bucket with a car, and each car with a scale, although the company have an outfit of eight railroad track scales, which would usually be considered a sufficient equipment. These car scales, which are fully shown in the accompanying drawings, are each of 15 tons capacity, and are constructed in an especially strong and durable manner, to withstand the particularly rough usage caused by being hauled about by a locomotive with hardly more care than as though they were ordinary freight cars. The levers have steel pivots cast in and afterward driven out and hardened. The levers, which are of the second order, are suspended by links so as to allow a slight swinging motion. This motion is limited by adjustable check-rods, and these castings in the scale are of steel. The knife edge pivots are of steel which has been subjected to Fairbanks' peculiar process of tempering. This steel is worked from the square bar, slightly flattened on three corners, leaving the fourth for the knife edge, this angle of 90 degrees having been found the best for combined accuracy and durability under a heavy load. A broken pivot exhibits a silvery-white fracture at the knife edge, and a grayish metal with a long fibre for the body of the pivot, these combining the ideal qualities, toughness and strength, with an extreme hardness at the edge. The load comes upon the four main levers, and is transferred to the extension levers greatly reduced, and from this the load passes to the weighing beam, which is of the kind known among furnace men as a charging beam. It consists of several beams, each of which may have its poise set to a different amount by the weigh-master, and the whole locked up beyond control of the workmen. In use, the beam desired is thrown into operation by a thumb latch, and a sufficient quantity of the material desired is drawn into the bucket to balance the beam. The laborer does not know the weight of the material, so in this way the composition may be kept a secret, and is at all times safe from a careless or incompetient weighman.

The further travels of this bucket are interesting. After being loaded, the bucket is seized by a hook and drawn up an incline to the mouth of the furnace, and lowered down until its flange strikes the rim of the furnace. The bottom of the bucket, which is of the form of an inverted cone, continues to be lowered, allowing the contents to drop out around the edge, thus insuring a uniform distribution to the furnaces.





The Yerkes Telescope Lens.

Two pieces of glass, valued at about as much as seven or eight locomotives, the value in each case representing the labor cost, should be an interesting subject to every worker. The disks forming the lens of the Yerkes telescope, the largest in the world, the culmination and conclusion of the life work of the last of the Clarks, whose death we were lately called on to record, are 41½ inches in diameter with 40 inches of clear aperture. The outer disk, of crown glass, is a double convex lens, 2⅜ inches thick at the center and ¾ inch thick at the edge and weighs 205 pounds. The inner disk is of flint glass, it is plano-concave, 1⅛ inches in the middle and 2 inches at the edge and weighs 310 pounds. These two disks are separated by several inches in the telescope. The focal distance of lens is 61 ft. The glass castings, as we would call them, for the disks came from the factory of Montois in Paris, and in the rough cost $20,000, while for the subsequent work on them Mr. Clark received $40,000. It is stated that a year was spent in preparing the material and in casting a dozen or more before satisfactory ones were secured. Even then each had to be cut and recut before all the air bubbles and inequalities were carved out. The care, the skill and the patience expended in grinding the lenses is marvelous. Little machinery is used and there are no secrets as to the manipulation. The lens maker's art is perhaps the highest form of handicraft and patience is its main factor.

The glasses, each separately, had first to be tested for striae, or streaks. It was set on edge midway of a large dark room with a light at one end, and the examiner at the other. An assistant held a lens between the light and the disk, and the rays as they were intensified upon the disk magnified the imperfections. The glass was next tested for polarized light, being viewed in the outer light through a revolving Nicol prism. All this was preliminary and after these tests the glass was ready to be shaped. It was first ground with hardened steel crushings, between iron and steel molds revolving with an eccentric motion, then followed ten courses of emery of successive grades, until it began to assume approximately its proper form. Here the fine work began, measurements as minute as 1-60,000 of an inch being involved. The final shaping, correcting and polishing were done with beeswax by hand, this alone requiring months of time and illimitable patience. After all the lens was mounted in a temporary tube and tried for fifty nights and was said to be perfect. The price paid was not too great. The business, after all, is not of the kind to grow rich in.

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Circular Milling Breech Rings of Built-up Guns.

Reference has been made several times in our columns of late to the process of circular milling, and attachments for performing that operation have been shown. The growth of this operation in favor is well illustrated by the accompanying outline engraving which shows the heaviest piece of work of this class with which we are acquainted. The piece being operated upon is the breach ring of a large built-up gun, which is clamped to a circular table which again is mounted upon the table of a horizontal boring and drilling machine. The spindle carries a shaped milling cutter and the table is provided with a power feed. The machine from which the illustration was taken is a No. 2, constructed by the Niles Tool Works, Hamilton, O., to whom we are indebted for our information.

There can be no doubt that this system of circular milling is adapted to a far wider field of usefulness than it has so far been applied to.

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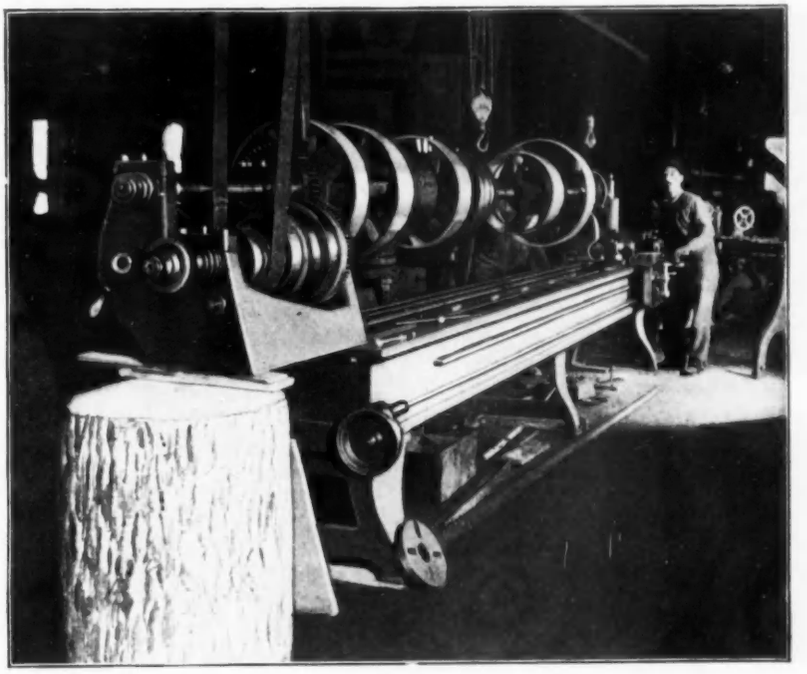
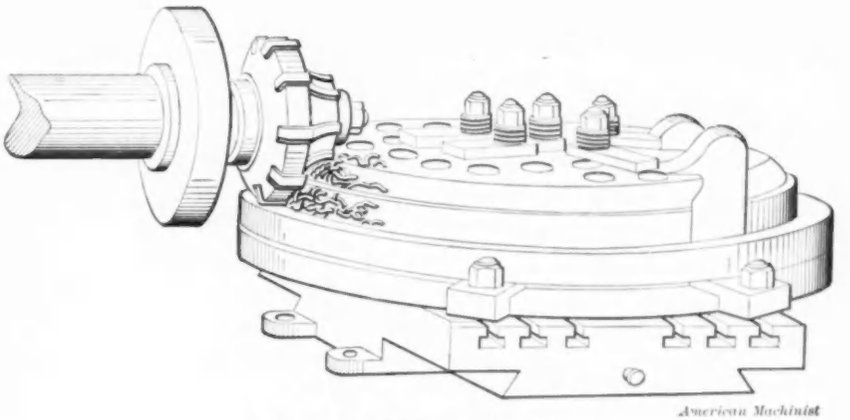
A Long Job.

The half-tone shows the interior of the Wapakoneta machine shop, at Wapakoneta, O. The lathe is a double-spindle lathe with 16-foot bed. This lathe has been illustrated and described in our columns. The one here shown happens to be the very first one of this type built by Dietz, Schumacher & Boye, of Cincinnati, and is without the later improvements in design and detail. The lathe seems to be especially adapted to the jobbing shop, but the job here illustrated was a sticker even for it. A length of line shaft was brought in as long as the lathe bed, and with a lot of large pulleys on and flange couplings on the end, and the couplings had to be faced off. The high spindle enabled the lathe to swing the pulleys all right, but that would not help about the length. The head stock was carried back and blocked up as shown, so that it only held on to the ways by an inch or so. The tail stock was also taken off, and special arrangements were made to run the rest as far off the end as necessary. Then one coupling was strapped to the faceplate, and the other end of the shaft was run in a steady rest just inside the coupling; another rest being improvised for the middle of the shaft. With this arrangement no difficulty was experienced in facing the coupling and doing the other necessary lathe work. We cannot but wonder what would have been done if the lathe had been a couple of feet shorter or the shaft a couple of feet longer. There can be little doubt that the job would have been done all right. The average country machine shop cannot be stuck by any little job like that.



A LONG LATHE JOB.



HEAVY CIRCULAR MILLING.

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Great extremes of temperature are found in our city for men to work in. In the sugar refineries large numbers are employed in an atmosphere at 140 degrees Fahr., while in the cold-storage houses the thermometer is at 32 degrees and below. For sedentary pursuits, the range of comfortable temperatures is not more than 20 or 30 degrees. There are indications that more attention will soon be given to the regulation of temperatures by artificial means in summer as well as in winter. One place of amusement is now advertising a constant temperature of 65 degrees.

Elasticity and Fatigue.

BY H. K. LANDIS, E. M.

In construction work requiring high specification material of steel, the qualities under discussion are of paramount importance. Every part of a structure must be designed so as not to be liable to any incipient permanent deformations, as well as not to attain to any permanent set or breakage. No part must break in service by reason of insufficient initial strength; likewise, no part should receive a "permanent set" under the usual working loads. These principles are of the nature of axioms to the designer, who has very largely discarded ultimate or breaking strength in his calculations, and substituted as a basis for strength the factor usually known as the "elastic limit." This factor, however, is of two kinds, the apparent and the true limit of elasticity, and here the designer is liable to be at sea by reason of the fact that there seems to be no standard method for the determination of elastic limit.

The usual methods of recording the point where the beam of the testing machine suddenly drops, or the stage of tension where a release of load gives a greater micrometer measurement, are shown by Krenzpointer, of the P. R. R. testing laboratory, to be points which vary with many factors; he found himself a difference of 2,000 to 5,000 pounds between the two determinations mentioned, and shows by experiments how the jog in a test piece may be mistaken for the elastic limit determination. In fact, if we care to look into the matter, we will be repaid by some revelations which may account for some unaccountable breaks in apparently safe material, and lead us to ask for an elasticity determination which can be relied on. And it may be well at this point to see what our technical allies, the Germans, are doing: For a considerable length of time they have been determining a factor, in addition to the usual limits, which they call the "limit of proportionality," or the point below which the elongation of test specimens is proportional to the applied loads; above this point the elongation begins to become relatively greater. As our inability to measure extremely small variations prevents us from securing the first of these gradually increasing increments of elongation, the French commission on tests defined the limit as the point where an increase of load of 1 kilogram per square millimeter caused a test piece 8 inches long between points to increase in elongation one 1,000th millimeter. To make the points take their relative position in steel, we may say that a mild steel having a limit of proportionality of 25,000 to 30,000 may have an elastic limit of 35,000 micrometer measurement for "set") or 38,000 (drop of beam), and a tensile strength of 55,000 pounds per square inch. Bauschinger found a difference between limit of proportionality and elastic limit of 6,000 to 7,000 for iron and 4,000 to 5,000 pounds per square inch for Bessemer steel; Professor Wedding found in a nickel-iron alloy a difference of 10,000 to 30,000 pounds per square inch; while Moulan found 22,000 in a 0.06 per cent. carbon steel.

We may define elasticity as the property of steel which allows it to return to its previous condition after being forcibly diverted from it by an external force. The condition of steel between the proportional and elastic limit is therefore not a condition of elasticity at all, but rather a state of progressive deformation which at the elastic limit (as determined) becomes so great as to be easily measured by ordinary apparatus. The customary determination of elasticity is therefore very crude and unsatisfactory, and there seems to be no very good reason to hold to it. Testing engineers realize the difficulty of securing satisfactory determinations of elastic limit, while the determination of the limit of proportionality is comparatively easy. With the latter, a load is applied to somewhere below the point expected, and then it is increased by equal increments until the rate of elongation begins to increase. Professor Wedding used on the Martens 50-ton testing machine, at the Laboratory of Industrial Mechanics at Berlin, a reflecting extensometer (see also Mirror Apparatus, "American Machinist," February 11, 1897) to which a small mirror was attached, reflecting a ray of light onto a graduated arc at some distance; a telescope with cross-hairs measured the deflection of the ray of light by noting its mean position on the arc. He was thus able to get readings to 0.0001 millimeter; the successive loads applied were about 2,000 pounds, gage marks on bar were 4 inches apart, and the limit of proportionality lay at the point where the stretch was from 0.03 and 0.06 per cent. for 1 and 2 kilogram loads. This, therefore, involves no extraordinary precautions, and gives very satisfactory results. Instead of the limit of elasticity being at two-thirds the tensile strength, the true limit of elasticity is about one-half the tensile strength. The older engineers have noticed repeatedly that members would fail at repeated stresses of two-thirds their strength, while their life would be much longer when these stresses were but half the ultimate strength of the material.

By fatigue we mean the gradual loss of resistance due to repeated applications of stress, and by the life of a member the time in service. The life of a material under repeated stresses, according to Wöhler, depends upon the range between greater and lesser stresses. There seems to be a more important factor than this, and that is the position of the greater stress with reference to the true elastic limit. To illustrate: Watertown Arsenal tests on Gautier steel bars of 0.341 per cent. carbon, with a limit of elasticity (first permanent "set") of 52,000, tensile strength 88,390 pounds per square inch, have broken when loaded to a fibre stress of 35,000 pounds per square inch at 14,093,000 revolutions (reversed stresses), under 40,000 pounds at 276,620 revolutions; 45,000 pounds, 195,410 revolutions; 50,000 pounds, 97,720 revolutions; 52,460 pounds, 67,950 revolutions; 55,000 pounds, 63,300 revolutions. We note here that, in going through the probable true limit of elasticity, between 35,000 and 40,000 pounds unit stress, the life of the rotating loaded bar decreased from 14,000,000 to less than 300,000; that, in passing through the supposed elastic limit, its life decreased (between the fibre stresses 50,000 and 55,000) from 97,720 to 63,300, showing very plainly that in these six bars thus taken there was a progressive fatigue and destruction evident above the limit of true elasticity. In fact, in the numerous endurance tests made by Sondericker, Hodgkinson, Baker, James, etc., this same relation is evident. Sondericker further says: "The elastic limit does not appear to be a sufficient criterion for judging of the capacity of material to resist repeated stresses." Endurance tests are the closest to working conditions, and if future investigations show conclusively that steel is comparatively elastic up to the limit of proportionality, that progressive destruction takes place slowly between it and the elastic limit, and rapidly between the latter and stresses up to the ultimate strength, we certainly shall be compelled to use the limit of proportionality as a basis for calculations, if we want the structure or machine to withstand the stresses of ordinary service for a reasonable length of time.

It may be of some interest to look at the usual method employed in testing laboratories for the examination of the mass of commercial steels, and to see what the elastic limit (E. L.) as reported really means.

Structural shapes, rails and commercial steels, usually made in a Bessemer converter, sometimes in open-hearth furnaces, are usually sold by the "heat" tests, i. e., chemical and mechanical tests are made on small test ingots of several pounds' weight which have been taken while casting the regular ingot. These are either rolled or hammered into uniform shape (whether very hot or too cold is never known), cooled (whether very slowly or very rapidly unknown), sent to testing machine in the rough, measured (as nearly as possible), two dents made on bar about 8 inches apart, and bar placed in the jaws of the testing machine, usually of the lever type. This machine has its power furnished by a screw worked by hand or from a line shaft, or by hydraulic pressure furnished by duplex pressure pumps; the tension thus acting at one end of the bar is opposed by the crosshead and jaws at the other end, which are connected by compound levers with a scale beam, just as weigh-

ing scales are constructed; tension causes the beam to rise, a weight is moved along to keep it swaying freely while the load or tension is gradually applied. Henning has found the friction and inertia to amount to 6 to 8 per cent. in such a machine, where a mercury gage was used to measure pressure. In a works laboratory the steel is quite regular and the approximate position of the elastic limit is known; the tension therefore increases until this point, when the beam suddenly drops, to rise again very slowly as tension increases; this point is the "drop of beam" elastic limit.

If greater accuracy is insisted on or high carbon steel is tested, a pair of dividers, or an 8-inch gage, is applied to the dents in the test bar, as tension and consequently stretch increase, and the elongation due to successive loads noted. Within a few thousand pounds or so of "permanent set" the rate of stretch per unit of time or unit of load perceptibly increases, rapidly for very low-carbon steels and very slowly for high-carbon or high tensile strength steel, until a decided increase is noted, which is called the elastic limit (first set), beyond which, within a few to 5,000 pounds unit stress, the drop of beam occurs. This point is determined more accurately on the Emery or other more finely adjusted machines, by applying successively about 500 pounds unit load and releasing it; when the test piece returns exactly to its former position an electric bell rings; if it does not return a micrometer screw determines the permanent elongation or set, and the elastic limit by permanent set is established.

It will be noticed that both these limits are built on assumptions—one that elasticity ends where breaking-down begins, the other defines where only a part of the material begins to fail. The limit of proportionality, however, is based on the theory of Wertheim, that in all elastic bodies the ratio of stress to the change of form produced is a constant quantity; consequently, as soon as the rate of stretch becomes greater than previously obtained, the body is no longer elastic; this limit is, therefore, based on elasticity, not on deformation. The presence of initial stresses and partial local deformations in steel makes the elastic determination sometimes very difficult. It were far better to have two series of tests: First—A quality test by usual tensile methods on material annealed by a standard method. Second—A condition test where the steel is tested by bending, impact, endurance tests, or other methods suggested by the purpose for which the product is intended.

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The maze of rigging and ropes has largely disappeared from our ocean-going craft, but it has been replaced by a maze of wires and piping below the deck. The modern steamer is not simpler than the sailing ship.

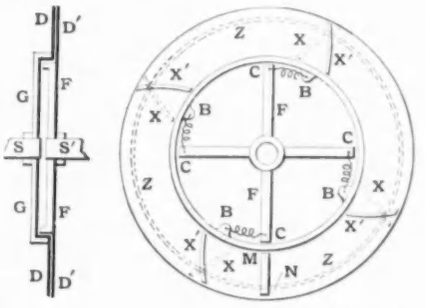
A New Form of Transmission Dynamometer.*

BY FREDERICK BEDELL, ITHACA, N. Y.

The accompanying paper by Dr. Bedell describes a very beautiful and ingenious device which has been employed by him for some time past in the laboratories of Cornell University, in various researches in which he has been engaged. One of its suggested applications is, among many others, that here indicated. It would seem practicable to adopt it, in special cases, for use as the indicating system of a transmitting dynamometer. It has performed such admirable work in its originally adopted place that there can be little doubt in the minds of those who have seen it in operation that it is capable of further useful application. This conviction has induced the request with which Dr. Bedell now complies, that he would describe it to the members of the American Society of Mechanical Engineers.—R. H. THURSTON.

THE BEDELL DYNAMOMETER.

The apparatus which forms the subject of this paper has not been employed as a dynamometer, but has been used for some years in a different form in experiments upon synchronous motors. The instrument has given such satisfaction that it is with confidence that the application of the principle to the transmission dynamometer is advocated.



American Machinist

NEW FORM OF DYNAMOMETER.

The dynamometer is shown in Figs. 1 and 2, which have been drawn to show the relation of the parts rather than the actual construction of the instrument. The shafts S and S' are the two shafts between which the power is transmitted; these are arranged in line and with ends abutting. The shafts are connected by any convenient system of springs; this system may consist of a single spring or a number of springs, which may be either for tension, torsion or compression. The annular disk D, is supported by the frame G, is carried by the shaft S. A similar disk D', supported by the frame or spider F, is carried by the shaft S'. In the particular form shown, the frame G carries four lugs B, which are connected to the spider F by the springs $B\,C$, which may be either springs for tension or compression.

The exact arrangement of the spring connection between the shafts S and S' has no direct bearing upon the principle of the dynamometer, and any form of connection may be employed which is found most convenient.

Let us suppose that we have the shafts S and S' running, let us say, at a constant speed and with a variable load; that is, the shaft S is transmitting an unknown and varying amount of power to the shaft S'. When the shafts are idle they have a certain angular position with relation to each other. When they transmit power, however, the shafts depart from the zero position with reference to each other by an angle θ, which depends upon the strength of the springs and the torque between the two shafts.

To determine the amount of power transmitted from one shaft to the other, it remains to determine this angle θ by which one shaft is displaced with reference to the other. This angle θ may be determined by the following simple method, which constitutes the distinctive feature of this dynamometer:

In the disk D are slits $X\,X\,X\,X$; corresponding slits $X'\,X'\,X'\,X'$ are in the disk D'. These slits are slightly curved, as shown in Fig. 2, the exact curvature necessary being explained later. The slits in one of the disks are the exact counterpart of the slits in the other disk, curving however, in the opposite direction. The slits thus superposed give a single point of intersection. As the shaft S' is turned through an angle θ with reference to the shaft S, the slits X' shift with reference to the slits X, and the point of intersection of the two slits is accordingly moved inward or outward from the center of the disks. The openings formed by the intersections of the slits will show a continuous ring of light Z, if the disks are illuminated from behind. For a constant torque the position of this ring of light will remain constant. The ring of light will, however, move inward or outward as the torque varies.

The slits are made of such a curvature that the change in the radius of the circle of light Z is directly proportional to the change in the angle θ, that is, to the torque.

The instrument may be direct reading, and experience has shown the following form to be convenient. An incandescent lamp is placed behind the disks. This lamp is enclosed in a suitable opaque box so that it illuminates only the disk. In front of the disks is a stationary opaque screen covering entirely the whole apparatus. In this screen is a ground-glass window $M\,N$ (see Fig. 2). The incandescent lamp is behind the two disks and directly opposite this window. Instead of a complete circle of light Z we only see a line of light across this window. The scale at the side of this window shows the horse-power direct for a given speed, as shown in Fig. 3. As explained above, the

* Presented at the Hartford meeting (May, 1897) of the American Society of Mechanical Engineers.

slits are made of such a curvature that the divisions of the scale in Fig. 3 are equal. The position of the line Z in Fig. 3 indicates 6.3 horse-power at a speed, let us say, of 400 revolutions per minute. When the speed is not maintained constant, it is necessary to determine the speed and to correct the reading accordingly.

It is thought that such a dynamometer, being simple and direct reading, will prove convenient not only in testing dynamos, turbines, engines and revolving machinery of all sorts, but that it will find a useful place in power-houses and factories. Thus the enginer in charge of a station, cable-house or factory can at a glance see the exact amount of power which is being used, and he can regulate his turbines or the supply of steam to suit the demands.

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Power of Portable Compressed Air.

BY FRANK RICHARDS.

The following note I was glad to receive and am glad to answer to the best of my present ability. The writer says:

"I read with interest your articles upon the advantages of a public supply of compressed air, as far as you went with them, and I certainly would have some use for such a system if established, but it does not seem to be in sight yet; and now I venture to ask you if you could give me some idea of what could be realized from compressed air at high pressure contained in proper receivers and delivered to customers to be coupled to their pipes, just as soda water fountains are supplied. I have specially in mind the running of a sewing machine or such work as that around the house, or a little lathe for amateur work. I can only work at odd times, and I can't afford to waste any time in getting up steam or starting any kind of a motor. I want to turn it on and let her go, and at the same time be able to regulate my speed and power by the throttle, and then shut it off and clear out at any moment if I want to. Then you know how a sewing machine is run in a house, at odd times, at different speeds, and stopped and started just as circumstances allow. A motor that would be always ready and always under absolute control, and without waste or cost except when doing something, and then only for what was done, would be a good thing to have."

A permanent supply of air at working pressure brought into the house as the gas and water are would be the ideal supply, but the system of transported tanks is also worth looking into, at least as an opening wedge for the more elaborate system. The portable receiver supply is readily possible in New York City at this moment. When this comes to the eye of the reader there will be in operation here two distinct plants where a constant supply of compressed air is maintained at a pressure of not less than 2,000 pounds, for operating motor cars, and the charging of portable reservoirs would be really an advantage to their service rather than otherwise, as they could be filled in the intervals between the charging of the cars, and so help to equalize their work.

The receivers used may be of any convenient size for handling, and ideas may vary upon this point, as upon most of the others. The weight in proportion to the volume of air contained will be nearly the same whether larger or smaller receivers are employed. If we have a receiver, then, say, 8 inches diameter and 5 feet long charged to a pressure of 2,000 pounds gage, its cubic capacity will be: $8^2 \times .7854 \times 5 \div 144 = 1.7$ cu. ft.; and if charged to 2,000 pounds the volume of free air would be: 14.7 : 2014.7 :: 1.7 : 232.99, or say 233 cubic feet. As we will see a little further along, we propose to use the air at a pressure of 100 pounds, and the volume at that pressure will be: 114.7 : 14.7 :: 233 : 29.8, say 29 cubic feet. The actual power cost of compressing the contents of the receiver will be considerably under one cent, and if we put the cost to the air compressing company at two cents, we allow a liberal margin for all other expenses involved in the compression. The chief cost would be in the transportation of the receivers rather than in the compressing of the air, thus showing the enormous advantage of the pipe system. The weight of the receiver would be about 175 pounds, so that it might be preferable to use those of half the capacity and half the weight, so that they would be easy to handle. The system of coupling might provide for the successive coupling of any number of receivers, one to the other, that a customer might want at the same time. Whoever delivered the receivers would uncouple and remove the discharged ones and couple those recharged, so that there would be absolutely nothing for the users to do but to open the valve as the air was wanted. Each receiver should be provided with a safety valve of its own. This is necessary because there is a possibility of the reciver being placed at some time where it and its contents may be considerably overheated, thus increasing the air pressure. Many soda water reservoirs have exploded on account of exposure to the sun for a considerable time. The safety valve is of course only necessary during the transportation or storage of the receiver, as when connected for use there will be a permanent safety valve in the system.

In considering the use of the air, it may be remarked, first, that there will be no possibility of its freezing up. After the compression and cooling of the air, the water contained in it will have been so completely drained from it that in its subsequent use at a considerably lower pressure it will be abnormally dry, and however cold it may get at the exhaust, there will be no precipitated moisture there to freeze, and consequently no freezing. In this respect the air compressed to a very high pressure, as would be necessary for economical transportation in isolated receivers, and then re-expanded to a practicable working pressure before using, will be drier, and so far better, than air transmitted through a pipe system at the working pressure and used without previous re-expansion.

As close as possible to where the receiver is coupled on, there should be placed a pressure reducer, through which all the air must pass, the pressure reducer maintaining a constant working pressure beyond it of, say, 100 pounds. As the air passes the reducer, its temperature falls with its re-expansion; its available volume is also proportionately reduced for the time, and means must be provided for its restoration to normal temperature before use. If it was simply made to traverse a long, thin coiled brass or copper pipe, say, ¼ inch diameter and 100 feet long, it would be warmed by the external air; or if it stood for a short time in a receiver before use, it would in that way also be warmed up very close to the temperature of its surroundings. The air, in such quantity as is here contemplated, would require very little heat to restore it to, or even to raise it considerably above normal temperature. A small vertical drum with three or four thin tubes in it, and a gas burner or a kerosene stove burner below it, would make a very good reheater, and the power efficiency of the air used would be raised probably one-quarter to one-third above what we find in our succeeding computations, if the air was used with any constant and steady flow. As the air is heated easily, it also cools easily and rapidly, so that if a reheater of any kind is employed, it should be as close as possible to the motor where the air is used.

As to the motor to be used, it is not necessary to say much. The air will work nicely in any steam engine, with the advantage that there is no condensation to make trouble either when starting or at any other time, and perfect lubrication is assured with very little oil. It is quite desirable, however, that the engine should have a cut-off, and if an adjustable one, so much the better. A proper cut-off being provided, the governing, for so small an engine as we are talking about, would be done by throttling. As we here contemplate using the air at 100 pounds, the cut-off should be at one-quarter stroke, and the terminal pressure would be then one or two pounds above the atmosphere.

We may assume that we have a sewing machine to drive, that it requires one-fortieth of a horse-power to drive it, and that it runs steadily and constantly all day long. As a matter of fact, we know that a sewing machine does not run constantly, that it requires considerably less than one-fortieth of a horse-power when it is under way, and that, for domestic

use, it is only under exceptional conditions that it runs more than an hour or two a day.

With a motor having a cylinder 1 inch diameter and 1-inch stroke at 150 revolutions per minute, with air at 100 pounds pressure, cut-off at one-quarter stroke, the mean effective pressure would be 44 pounds, and the indicated horse-power would be: $1^2 \times .7854 \times 44 \times 25 \div 33{,}000 = .026$, or a trifle over the fortieth of a horse-power required. The air consumption per hour would be: $1^2 \times .7854 \times 25 \times \frac{1}{4} \times 60 \div 144 = 2.045$, to which add 10 per cent., which makes it then 2.25 cubic feet per hour at 100 pounds pressure, and as we had above 29 feet at the 100 pounds pressure in the receiver, then $29 \div 2.25 = 12.9$ hours; but as all the air in the receiver could not be used, we may say that the supply contained in it would be certainly sufficient for a constant run of the motor at full power for at least ten hours

I have said nothing anywhere about the possible losses of air by leakage. I have not thought it necessary to do so. It is, of course, possible to lose all the air by leakage; but if the plant was looked after with only the care bestowed upon the average steam plant, the loss through leakage should be inappreciable. On the other hand, I have said little of the gain by reheating the air while using. The gain from this source, wherever practicable, would compensate for leakage and other losses ten times over.

The cost to the consumer of the quantity of compressed air which we have considered above, would be, under the system of public supply by pipe at the rate of 5 cents per 1,000 cubic feet of free air, only a trifle over 1 cent. We have assumed that the company charging and sending out the receivers should have 2 cents for the same quantity of air. The cost of delivery and connection of the tanks might be 10 cents or it might be 25 cents, depending upon the distance, but more especially upon the number of customers supplied. If we look at the actual power cost to the customer, and compare it with some other power-cost possibilities, the cost will be high; but if we consider the great convenience of it under favorable conditions, the cost drops almost out of sight.

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Cox's Strength of Gears Computer.

The various computers designed by Mr. Cox have been frequently referred to in these columns, and we illustrate herewith one of the more recent of these instruments for calculating the strength of toothed gears, which is of special interest because, through the co-operation of Mr. Wilfred Lewis, the instrument is now arranged by means of an accompanying set of tables, to work out all questions connected with gearing by Mr. Lewis' methods, which take into account the form and velocity of the teeth as factors in determining the load. The instrument is arranged to give either the dimensions of teeth required to carry a given horse-power directly, or the dimensions necessary to carry a given load in pounds at the pitch line. These two formulas, as solved by the computer, are as follows:

$$H.\ P. = c\,\frac{\text{pitch} \times \text{face} \times \text{diam.} \times \text{r. p. m.}}{126050}$$

$$\text{load} = c \times \text{pitch} \times \text{face},$$

all dimensions being in inches, and in which c is a constant obtained from the tables accompanying the instrument, which have been specially prepared for it by Mr. Cox from data supplied to him for the purpose by Mr. Lewis.

The method of using the computer to obtain the pitch necessary to carry the given horse-power is as follows:

1. Select a pressure coefficient and place it opposite the given horse-power.

2. Hold the disk and set the segment to bring the revolutions opposite the diameter.

3. Find the required pitch opposite the face which goes with it. All coinciding lines of face and pitch scales give teeth of the same strength, and from them a tooth having a desired ratio of face to pitch may be selected.

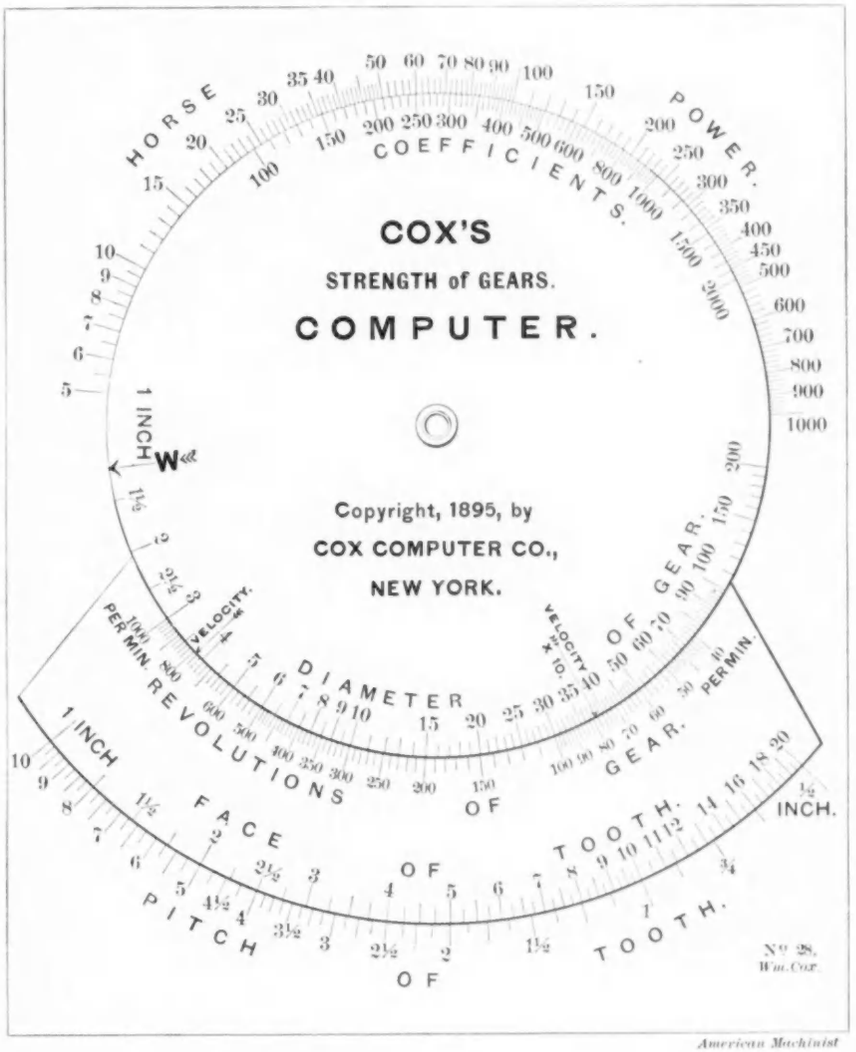
To find the working load upon the tooth in pounds, the procedure is as follows:

1. Set the face of the tooth to its pitch.

2. Bring the arrow marked *H'* opposite 1,000 revolutions per minute.

3. Opposite the selected coefficient find on the scale of horse-powers the value of *H'* in hundreds of pounds.

Inasmuch as Mr. Cox's tables are equally serviceable in using the formulas given above, and as they have not before appeared in print, we reproduce them below by his permission. The first table relates to the form and number of teeth and to the material used, while the second table relates to the velocity. To use the tables, select the number in the column for the form of tooth and the material which stands opposite the number of teeth, and multiply this by the value of *m* standing opposite the velocity in the second table. The value of this product gives *c* for substitution in the formula or the value to be used as the coefficient of the computer.



American Machinist

TABLE I.

No of Teeth.	Involute, 20° Obliquity.		Involute, 15° & Cycloidal.		Radial Flanks.	
	Iron.	Steel.	Iron.	Steel.	Iron.	Steel.
12	624	1560	536	1340	416	1040
13	671	1678	571	1428	430	1075
14	711	1778	601	1502	442	1105
15	746	1865	627	1568	453	1132
16	776	1940	650	1625	462	1155
17	803	2008	670	1675	470	1175
18	827	2068	688	1720	477	1192
19	848	2120	704	1760	484	1210
20	867	2168	719	1798	490	1225
21	885	2212	732	1830	495	1238
23	915	2288	754	1885	504	1260
25	940	2350	773	1932	512	1280
27	962	2405	789	1972	518	1295
30	989	2472	810	2025	526	1315
34	1017	2542	831	2078	535	1338
38	1040	2600	848	2120	542	1355
43	1062	2655	865	2162	549	1372
50	1086	2715	883	2208	556	1390
60	1110	2775	901	2252	563	1408
75	1135	2838	919	2298	571	1428
100	1159	2898	937	2342	578	1445
150	1183	2958	956	2390	585	1462
300	1208	3020	975	2438	593	1482
Rack	1232	3080	992	2480	600	1500

TABLE II.

Velocity ft. per min.	Value of m.	Velocity ft. per min.	Value of m.	Velocity ft. per min.	Value of m.
0	1.000	600	0.500	1400	0.300
100	0.857	700	0.462	1600	0.272
200	0.750	800	0.423	1800	0.250
300	0.666	900	0.400	2000	0.231
400	0.600	1000	0.375	2200	0.211
500	0.545	1200	0.333	2400	0.200

Other values of m can be found by interpolation, or by the formula $m = \frac{600}{v + 600}$.

▲ ▲ ▲

Measuring Pressures of Ten Thousand Pounds Per Square Inch.*

BY D. S. JACOBUS, HOBOKEN, N. J.

The pressure-measuring device consists of a steel plug *A*, ½ inch in diameter, fitted into a steel bushing *B*, the hole in which is 0.5005 inch diameter. The top of the plug *A* is fastened to the center of the wheel *C*. *E* is a steel plate which bears downward on the axis of the wheel *C*. There is a ball bearing *D* between the steel plate and the axis of the wheel. *G* is a circular base for supporting the apparatus.

A pressure is produced by means of a special device, not shown in the sketch. This pressure is transmitted to the measuring device by forcing oil through the ¼-inch pipe *F*. The oil pressure tends to raise the plug *A*.

The plug-and-wheel device is placed on a pair of platform scales, or in a testing machine arranged for tests of compressive strength, and the downward force *P* required to hold the block *E* in place is accurately measured. To this is added the weight of the wheel *C*, and of the ball-bearing device and plug, and from this total force the liquid pressure is calculated.

The wheel *C* is spun around when the weight *P* is measured, in order to rotate the plug and thus eliminate the effect of friction.

The pipe *F* which transmits the pressure is about 16 feet long, and bent in the form of a U, so that any little displacement of the pressure-producing device will not affect the reading of the platform scales.

If a gage is to be tested it is attached at *H*. The weight *P* required for a given pressure is calculated, and the scale-beam of the platform scales is adjusted so that it will register this weight. The oil pressure is then increased until the beam of the platform scales is raised, the wheel *C* being spun to eliminate the effect of friction, and when the scale beam is balanced the gage is read. The reading of the gage for various pressures is thus obtained, and the difference between the readings and the pressures as measured by the plug, gives the corrections for the gage.

This apparatus has been employed for calibrating gages to 10,000 pounds pressure, and for measuring pressures as high as 15,000 pounds per square inch, and has given entire satisfaction.

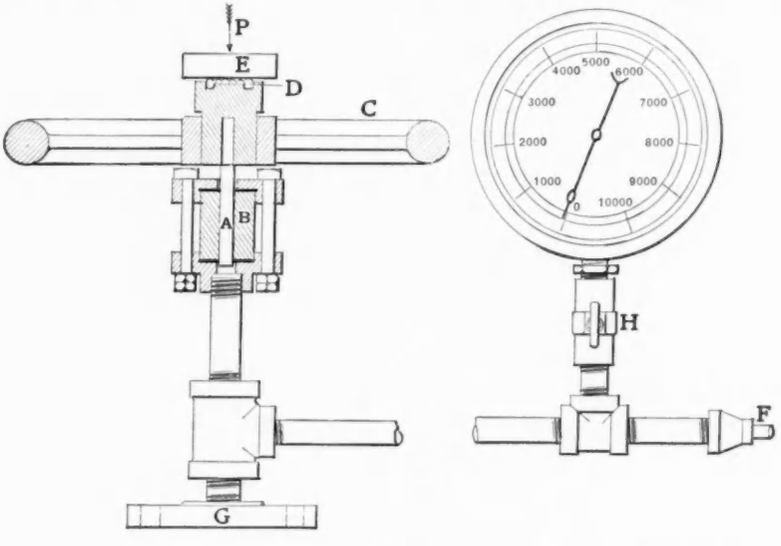


Fig. 1 *American Machinist*

MEASURING HIGH PRESSURES.

Lighting Vents in the Foundry.

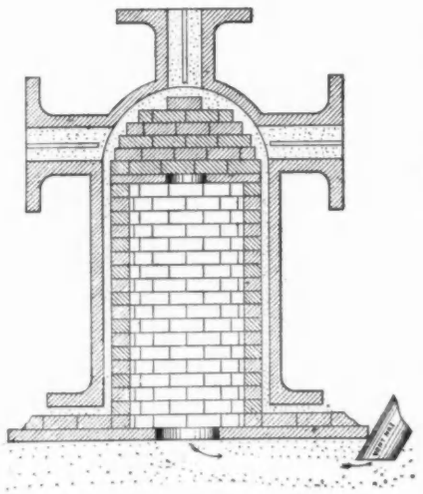
"Let me call your attention to one of the most popular humbugs in the foundry—the lighting of vents to carry the gas off more freely. As a rule, the instruction to the skimmer is to 'touch off' the vents as soon as they will light. The idea among molders is that this causes the gas to escape more freely, and thus lessens the possibility of a blow. This idea is a mistaken one, as I have demonstrated by practical experience upon more than one occasion. My conclusion is further verified by good authorities, who inform me that manufactured gas will escape just as freely from a gas jet whether lit or not, the flow depending entirely upon the pressure. With the gas coming from a mold in the process of casting, the pressure from within determines the velocity of the escape. The gas is forced through the vents, not drawn through them, and if they are too small for the volume of gas to be carried off, lighting them will not facilitate its exit or save a piece from blowing.

"I am not opposed to the lighting of vents, however; far from that, for I believe in it as a general rule, but not because it causes the gas to issue more freely from the mold. The molder does not need to be told that the gas issuing from a mold or core is both offensive and very suffocating, but will readily burn, and thus obviate the inconvenience that might otherwise have to be endured. That is the only good reason for lighting the vents, and if this were more generally understood by molders they would not be so anxious that the skimmer boy should neglect his more important duty to run around the box lighting vents, while the foreman, or perhaps the molder, when he sees something other than iron going into the runner head, yells at the unfortunate but obedient youth, in language more forcible than polite, 'Why don't you skim?' Countless castings have been lost through no other cause than this lighting of vents, at the expense of efficient skimming. Let every molder adopt the simple plan of allowing the skimmer to attend to his particular duty, and let the vents take care of themselves. Even when casting the most complicated work, I have always insisted upon this system, and feel that I always have a better casting.

"This advice, of course, has reference

* Presented at the Hartford meeting (May 1897) of the American Society of Mechanical Engineers.

only to dry and green sand work, and is not always equally applicable to loam work. In some classes of this work it is necessary to keep the vent from lighting during the cast. This is especially the case where there is hollow brick-work, in which gas will accumulate during the casting and become dangerous if not lit at the proper time or guarded against being ignited until the mold is full. I know of a number of instances in which the lighting of the vent of such molds at the wrong time has been followed by an explosion with disastrous consequences. My attention was particularly directed to a case of this kind a few months ago. I got the molder to draw a rough sketch of the casting they were making, and as nearly as I could gather it is shown in the accompanying illustration. I understand it was a nozzle for a chemical tank, and my informant guessed its weight to be about 1,800 pounds. He had been instructed by the foreman to light the shavings in vent No. 1 when they were ready to pour, and then attend to the others. This he faithfully endeavored to carry out, using a red-hot rod; but in some



VENTING A MOLD.

way the shavings in No. 1 either failed to light or died out, for by the time he had gotten the other vents lit the foreman was telling him, in high-toned language, to come around again and touch off this one. By this time his rod was cold, and he had to heat it up again before he could successfully light the vent. When he did so the gas ignited at the mouth of the vent, ran along the passage to the chamber in the center of the mold, and the accumulated gas at once exploded, shattering the mold into fragments.

"Now let us examine this catastrophe, and see how it might have been avoided. The sketch is the half section of the nozzle, showing part of vent No. 1, which has been referred to and which was the cause of all the trouble. It will be observed that there is only one way in which to carry off the gas that gathers in the hollow chamber of the brick core, and that is along the passage marked by the arrows, thence through the vent pipe. As soon as we begin to pour, a light, hot gas is generated, which, escaping from the surface into this chamber, at once rushes to the top, gradually expelling the air as it gathers in volume; when the chamber is finally filled with this gas, it begins to make its way along the top of the passage and up the vent pipe, at first in a thin streak, but rapidly increasing in volume till all the air is expelled from both chamber and passage and the vent pipe is full of escaping gas. Then was the time to light it, but not before. Why? it might be asked. This gas, then, is not only light and hot, but also of a highly explosive character. It is a well-known fact that no gas will burn or explode unless exposed to the oxygen of the air, that element which supports life and combustion. When the light was applied to No. 1 the second time the chamber had been filled with the gas and it was just beginning to make its way to the vent pipe, along the top of the passage, the lower part of which was still occupied by the unexpelled air, when ignited at the mouth of the pipe, then, instead of burning there, being fed by the air within, the flame ran quickly along the passage way, was communicated to the gas in the chamber, and as a natural sequence we had the explosion. Had the light been withheld a few seconds longer, in all probability the air would have been driven out and the danger over. It will be seen that had the shavings taken fire in the first instance the result would have been just the same and the explosion would have occurred at about the same moment. The lighting of the gas when the pipe is full is manifestly exactly the same as lighting an ordinary gas jet, and equally as safe.

"The proper time to light such a vent is, in my opinion, after the cast. To guard against accidental ignition, the mouth of the vent pipe should be covered with a sieve over which some loose hay should be sprinkled; this will furnish protection on the same principle as the Davey Safety Lamp in a coal mine. Some molders resort to the practice of filling the hollow parts with cinders or loose sand, which is very inconvenient sometimes and a useless waste of labor."—R. Watson, in "Iron Molders' Journal."

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Letters from Practical Men.

Broaching Babbitted Bearings—Facing Nuts True.

Editor American Machinist:

I was not disposed to toss my head, as Mr. Lawrenz supposed some machinists would do, on reading his plan of finishing a babbitted bearing, as described in your issue of June 24th. But I do think the method he adopts is open to criticism.

It is a matter of the first importance, as we all know, that a wheel which is to revolve on a shaft loosely should be made to fit the shaft as perfectly as possible; that is to say, the hole should be perfectly straight and cylindrical. It seems to me quite impossible to secure this accuracy by the expanding and broaching method described by Mr. Lawrenz. In the first place, the babbitt does not contract alike on all sides of the hole; especially will this be the case when the space around the mandrel is not of even thickness—a condition quite sure to exist in the example given. If I properly understand the form of broach used, there is nothing to prevent it from following any unevenness in the hole, and as this is the guide for the cutting edge which follows, the work done cannot be very accurate.

Allowing that the nature of this work does not require the strict accuracy of which I speak, yet it is evident enough that when the surface in a hole only touches the shaft in spots, that it must soon show signs of looseness when these spots wear off, and that this must occur in a comparatively short time.

If the point made with reference to the deviation of the broach from a truly central course through the babbitt be well taken, then it also follows that the wheel, when thus finished, will not revolve truly on its shaft; but, as I said before, this may not, in the case of cast gears, reach an objectionable limit.

I can easily conceive of conditions which might render the work described all right, but in such a case, why broach out the babbitt at all? The form of core may, of course, be such, in a hub, that any shrinkage of the metal will tend to tighten it; besides, the driving of an ordinary mandrel has a tendency to both straighten and tighten the babbitt.

For a first-class job of expanding, I have seen nothing so good as a mandrel fitted with a steel roller at its end; this in the tool post of a lathe may be passed back and forth through a hole until the desired solidity of the metal is secured.

In noticing what "Bell Crank" and others say about facing nuts true, I wish to say that, when it comes to downright accurate work, I have no faith in anything but a truly cut mandrel having a thread that fits the nut closely, and on which it screws sufficiently tight to hold against the cut which is to be taken. Of course, there can be no exception taken to the regular lathe with turret attachment, which taps and faces at the same chucking.

QUIRK.

▲ ▲ ▲

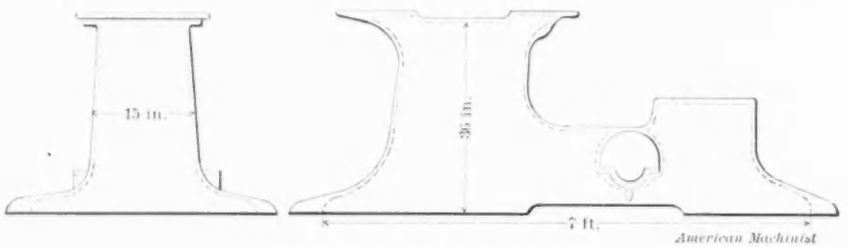
Custom versus Reason in the Foundry.

Editor American Machinist:

When a molder, who has attained a fair idea of the principles which underlie his craft, starts to work in a strange foundry he very often meets with customs which he soon sees are absurd, and which though followed for years, could not be in-

telligently explained by those who sternly adhere to them. When he gets well under way on some piece which he could, and would, turn out without waste of either time or material, he is apt to be told by the man in charge, "We never made it that way, we lose a great many of them, and we don't want to take any chances." The old way is then explained, and at once the stranger sees the defect of the practice, and he may instantly "pack up," or, if times are dull, he may decide to surrender his personal sovereignty for a while, and with little hope of success proceed as directed. About the same "bad luck" attends his efforts as it has those before him, and then he is saluted with the common ejaculation: "It is strange that you molders can't save these castings."

A short time ago it was the custom in one of the largest engine works in the country to put a head of from 24 to 30 inches on the crossheads, which were of charcoal iron, and the orders were to keep the riser full. Most of the molders knew what they would see when the riser was broken off if they did so; but if the boss did not watch them too closely they would pump for a while with a low head and get a solid casting. This was one of many instances in that foundry where authority and custom prevailed against reason.



MOLDED IN GREEN SAND.

In some iron foundries, in order to overcome the effect peculiar to some sands, commonly known as buckling or drawing, it is a common practice on molds in which any considerable amount of iron is to be poured, to resort to the torturing process of nailing the cope, and often the drag too. The curt reply to any inquiry about, or objection to the method, is invariably, "We have always done so, it is surer." It is not by a suspension of natural laws, that others, with the same grade of sand, turn out castings as heavy, and smoother, without the nails.

Too little attention has been given to sands used and what they will do. A notable instance in that line is the case of a heavy tool works which had very successfully obtained their castings in their original city, but with the same foreman and molders in another State, with a sand which was strange to them, good, yet having the peculiar drawing qualities, "bad luck," as they called it, attended them to the amount of many thousand dollars.

With a few exceptions it is the common practice to use—or rather misuse— a great quantity of distillery returns, or molasses water, in the mixture for cores. Although it retards the drying in the oven, causes the cores to get damp and sticky in the foundry, gums up the core boxes generally, and generates an enormous amount of gas in the molds, the inquirer will be told: "We have always used it, it makes the cores stronger." Coremaking is a grossly neglected branch of the founder's craft. Seemingly without consideration of the cost of sand which can only be used once, or the difficulty of obtaining the required thickness of metal, owing to the sagging and swelling of cores of any considerable depth, the cores for bases of bolt, and milling machines, and the like are usually made of dry sand. Any mechanic who has done his best to make a perfect mold, and had the prints crushed, thickness cut off, and small cores crowded out of place by an irregular dry sand core, will welcome anything that will do away with such distorted shapes. The sketch will give an idea of a resaw base which was formerly made with dry sand core with no little trouble from causes above mentioned. It is now made with green sand core with no trouble, and excellent castings are the result. The dimensions on the sketch are only approximately correct.

H. O'NEIL.

Dover, N. H.

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Harding's Apprentice.

Editor American Machinist:

John Corbin apprenticed his boy Joe to Austin Harding, to be taught the machinist's trade. Harding ran a little machine shop—nine men and one boy, when he could keep the boy—and a smaller foundry, both of which had come down to him through two generations of Hardings. Corbin was a first-class pattern maker—a much better patternmaker than Harding was a machinist. Like every real good mechanic in the country, Corbin thought any other trade better than his own, hence Joe was to be a machinist. Shouldn't putter his life away glueing pine together for a molder to knock to pieces in the sand; Joe shouldn't, so Corbin declared.

Corbin, like most good pattern-makers, was a methodical man. A machinist will scatter his tools all over the bench and spend considerable time in hunting for the particular one he wants during the continuance of a job, and sometimes use the one he does not want rather than spend the time to hunt up just the right one. When a patternmaker has finished with a plane, or a chisel, or a gouge, or what not, it goes right back to its place—one place somewhere—even if he knows he shall want it again in a half-hour. This may be exaggerating a trifle, but it is a good deal that way in the instance of the two craftsmen. One loses time from too little system in regard to his tools; the other from too much. After all, there is, sometimes, madness in too much method, as well as "method in madness."

But all this has nothing to do with Joe's apprenticeship. Corbin, being a methodical man, believed in having things done so they would stay done; wanted to know right where he could put his hand on them, is the way he put it. Had the papers drawn up in full legal form by the old Squire, and "signed, sealed and delivered." Joe was to serve his master "well and faithfully," and do and not do a lot of other things, for the period of three years, in consideration of which he was to receive a small monthly stipend and be taught the "arts and mysteries" pertaining to the trade of machinist, whatever that may all mean. Harding contracted to perform his part of the agreement, and Corbin stipulated that Joe should perform his.

Joe rattled around getting the "hang of the shop" the first forenoon, and in the afternoon got a job skimming ladles in the foundry. The second day Harding set him at work in earnest. Set him at work sorting over an old scrap heap, the accumulation of three generations of Hardings.

Corbin could not just see what this had to do with the arts and mysteries part of the indenture, but he did not say anything until the second week, when Harding sent Joe on a pilgrimage of two miles and back to borrow Carter's old worn-out three-inch reamer. Joe told the paternal party to the contract about it, and that evening Corbin interviewed Harding. The dialogue was like this:

"See here, Harding, Joe is indentured to you to learn the machinist's trade. That's what the papers say, about as plain as the Squire could make 'em say anything. Ain't a word in the document about skimming ladles in the foundry, sorting over old scrap heaps half under ground, or running all over the country to borrow tools to run your shop with; relicts of departed reamers, and the like. Such like work, if you call it work, hasn't got a blessed thing to do with the arts and mysteries of the machinist trade, not so far as I can see. You're breaking the contract right from the start. S'pose

you'll have that boy shovelling gravel or something of the sort next. You ain't doing as you agreed, not as it looks to me. Joe'll know less after he's been here three years than he does now."

"Yes, well that's because you don't know anything about the machinist's trade. Joe's come here to do just what I tell him to do, and he's going to do it if he stays. Do you suppose because a boy's going to be a machinist he doesn't want to know how to skim a ladle? Just what I said is true. You don't know a blamed thing about the business. Then his sorting over that accumulation of material that you call a scrap heap because you don't know any better, why, while he's been at that I've shown him how to tell cast iron from wrought iron, wrought iron from steel, mostly, and either from brass. Before he gets through with that job he'll know most as much about it as I do. Know a big sight more about the machinist trade than you'll know if you live fifty years longer. And it's just what a machinist has got to know, too. Tell which is which, Joe can, by feeling it with his hand, pretty much, and when he can't tell that way he's learning how to feel it with a sledge. Nothing to do with the machinist's trade. Well!

"Then about going to borrow that reamer. Now, look here, Corbin, suppose I'd put Joe turning pulleys and such like nice work, and kept him at it till his time was out, then suppose he'd wanted to start a shop of his own and didn't know where or how to borrow a tool when he wanted one he didn't have? Would you call that doing the fair thing by the boy? You know a good deal about the pattern-making business, Corbin, but you're way off on the machine shop business. Why, you can see it right in the workmen in the shop. Whoever heard of a pattern-maker borrowing saws, and planes, and the like, from another patternmaker? Whoever heard of a machinist that didn't borrow that way?

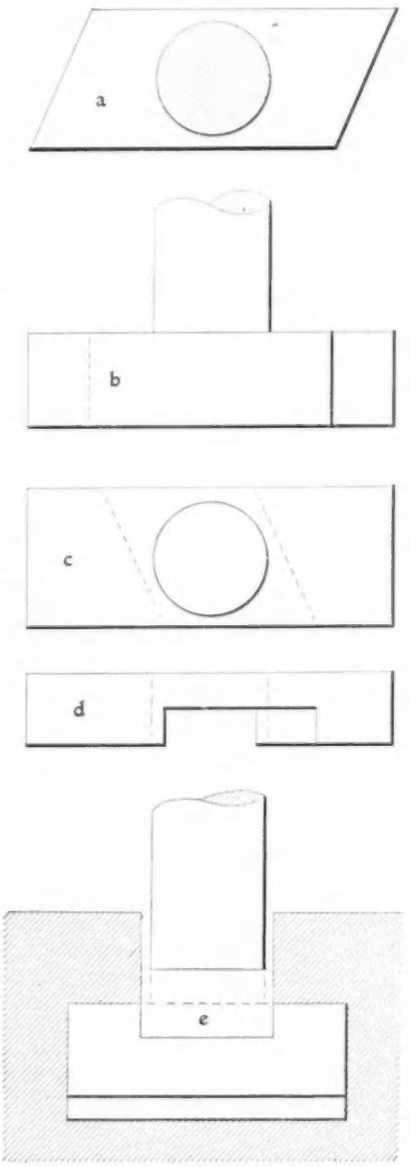
"Tell you what it is, Corbin; when you run a machine shop like that of mine you've got to hustle round and know how to do a lot of things besides chip, and file, and bore and turn. If you don't you'll be at the rear end of the procession. You just let Joe alone. I'm going to give him a chance to learn all these things, and that's what I call the arts and mysteries of the trade."

Corbin was silenced, but not convinced. He thinks an apprentice should have some rights as well defined by law as the rights of property. Thinks that it would dignify apprenticeship and make it more popular by giving it a standing that it does not have now. He believes that when a boy goes to a trade he should know of what the trade consists and how much of it he is to be shut off from as well as how much he is to do that has no sort of connection with the trade. I'm not so sure but Corbin is about right. F. G.

Holding Planer Bolts from Turning.

Editor American Machinist:

No doubt you recall, in the bygone days when you used to be there yourself, how you wished somebody would find a way to get planer bolts into and out of the T slots in the platen, except in the old-fashioned way of slipping them in at the end. I know I did, and in a country shop I one day ran across some bolts with parallelogramatic heads, as at *a* and *b* in the sketch. They go in easily at any point, and the heads, while not so strong as



HOLDING PLANER BOLTS.

square ones, stand well in good true slots. But the trouble is that when you back off and loosen the nut, the bolt sometimes turns the easiest, with damage to the bolt slot in the platen.

I have for several years used this form of bolts with a special head holder made, as shown at *c* and *d*. The diagonal cross slot on the bottom of the plate is just wide enough to embrace the bolt head easily when slipped over the bolt. It is about $\frac{3}{16}$-inch deep in a $\frac{5}{8}$-inch piece, and our bolts are $\frac{5}{8}$-inch, used in a $\frac{3}{4}$-inch slot. The holder lies entirely within the bolt slot when in use, as at *e*. It is easily raised by the thumb and finger over the ends when desired, and for my use is very satisfactory.

The plan of having several T-shaped nuts in each of the slots all the time, and using plain straight rods, threaded on each end for bolts, has the advantage for some kinds of work, but not for all.

CHARLES S. BEACH.

Bennington, Vt.

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Section Liners.

Editor American Machinist:

I notice that perennial subject of misplaced ingenuity, the section liner, again makes its appearance in your columns. I have made a good many drawings during the past fifteen years, and have cross-hatched a good many square yards—I suppose I might almost say acres—of paper, and I have never been able to see what anyone should want of one of these things. No one does close cross-hatching in these days, and if the hatching is not closer than, say, twenty lines to the inch, anybody can soon learn to do it well enough to suit the most critical without fussing with any of these traps. I would like to have someone tell me what they are for, anyhow.

C. O. GRIFFIN.

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Speed Ratios in Grinding.

Editor American Machinist:

I was glad to see the question of speed ratios in grinding machinery brought up by Mr. O. S. Walker in last week's "American Machinist." We have been rather unsuccessful as regards time on some rolls and want further light on this question. Neither from the articles in "American Machinist" nor from the pamphlet sent by one of the Norton emery wheel men could I get what we wanted.

I would like to see some data on speeds and feeds for different metals and work. These glittering generalities are all right, but to some of us who have contracts to fill, a few points as to speeds and feeds would be much appreciated.

WM. SANGSTER.

Jamaica Plain, Mass.

▲ ▲ ▲

The effect of European business in American machine tools is plainly shown by the manner in which our lathe builders are bringing out small lathes having compound rests. Whether this indicates progress in anything, except trade hunting, is something of a question. We have never been able to see the utility of the compound rest on small lathes.

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Patent Agents.

We receive a great many inquiries asking us to recommend a patent solicitor or else asking about some individual solicitor. These letters usually ask about the honesty or reliability of the solicitor, the writer being obviously afraid that his invention is not to be trusted in many agents' hands.

There is very little direct stealing of inventions on the part of patent agents. An invention is undoubtedly safe in this particular in the hands of most any of them. The industry of "working" the inventor, and of practically swindling him, is conducted on far more refined and subtle lines than theft, and consists in taking the inventor's money, and then through incompetence or haste, drawing up the papers so carelessly that the patent, when issued, is practically worthless. The practice is essentially dishonest, though it scarcely comes within the cognizance of the law, and the industry of taking out patents is in fact one in which the strictest technical honesty may be maintained, while every patent taken out may be to all intents and purposes a swindle. Our recent editorial on this subject explained the difference between a good patent and a poor one, and showed wherein ability of a high order, as well as industry and painstaking care are necessary on the part of a solicitor in order to do justice to his clients. In the ordinary case the inventor is dependent upon this ability and industry for the value of his patent, which will explain why, in our opinion, it is unwise to go to any of the large patent agencies, no matter how pretentious or of how long standing and "upright" record they may be, in order to patent any invention. The personal qualities of the man who draws the papers determine the value of the patent.

From the nature of the case the work of these large agencies is done through clerks, who like clerks in any other business must give a return to their employers, adequate to their salaries, and this return depends upon the number of patents which they draw. The agency has no interest whatever in the real value of the patents, as the general public, with whom they deal, cannot distinguish a good patent from a poor one. The agency is practically a patent factory, and the larger the output the greater the profits. Were these conditions otherwise, it would be a mere matter of chance whether the clerk in whose hands a given patent falls is capable or incapable; but being as they are, the best intentions on the part of the clerk himself would only stand in his own way, since the securing of good patents requires time, and such an aim on his part would only reduce the number of patents which he obtained. Under these circumstances it is inevitable that such patents will be drawn with the aim of getting them through the office with as little labor as possible, which is only another way of saying that the claims will be so narrow that the examiner cannot object to them, a state of things which it will be seen is directly counter to the inventor's interests.

We believe the only course to follow is to go to some solicitor who does his own work, so far as the writing of the specifications and claims is concerned. Such a solicitor should be selected, if possible, after consultation with persons of experience with and knowledge of patents. It is also desirable that he should be, if possible, so located as to permit of consultation between him and his client.

The occupancy of a large office building in some large city gives the solicitor no advantage, whatever, and while in some cases a location in Washington, or a trip to Washington, is an advantage, and even occasionally a necessity, it is, in the average case, of less importance than a full understanding of the case on the part of the solicitor, which can be best obtained by consultation between him and his client.

Of course it will be understood that a considerable percentage of the papers comprising every patent application are of a purely formal nature, which may be satisfactorily prepared by clerks, and it is easy to see that an expert solicitor might satisfactorily direct the work of one or two assistants, but there can be no question that a soliciting office which delegates the drawing of specifications and claims to clerical labor, is to be looked upon with suspicion and avoided if possible.

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Good Enough.

Good enough is not, as some would have it, an altogether disreputable expression. Good enough is good enough when it is good enough, and when it is good enough nothing better can be any better than good enough. The good enough standard of workmanship and production is not to be hastily and altogether condemned. Good enough is always good enough in its place, but out of its place it can never be good enough. Good enough, wherever it is, must first of all certainly be good enough, and ninety-nine per cent. good enough should never be accepted at par.

There is a theoretical and a practical good enough, and, as with theory and practice everywhere, the practical is the only sure winner. When good enough gets into the shop theory and practice seem to change their traditional places. The shopman, the most practical of men as we think of him, becomes sometimes the theorist, with the deficiencies and the limitations of the theorist, when he assumes to determine what is good enough. A man may turn out a piece of work which, according to all the knowledge that he has, and according to his theory formulated upon that knowledge, may be good enough, but the practical man for whom the work is done may for practical reasons reject it. A manufacturer may turn out a machine that may be better than any other in the market, and at the time good enough, and as long as it will sell he may have no hint that it is not good enough; but if he does not continue to improve it will not be good enough for long, because it will not then be as good as the machine that some other fellow is building. Good enough is never a fixed standard; no good enough is good enough for long. Good enough is not to be permanently set upon a post, but should be mounted on wheels with anti-friction rollers for the axles, and it should constantly be shoved along.

The good enough test is sometimes unfairly applied. Good enough for nine-tenths of our wants gives us cheap and generally satisfactory production. It would be a mistake and an injustice to make all the product good enough for the other tenth; because it would entail on the many an unnecessary and useless expense. The price to them would then be far from good enough. As far as the evidence in the case goes our pulley practice is good enough for most of our work. To make every pulley accurately to size, instead of, as now, finishing them with as little cutting as possible, would, perhaps, not make them any better than the present good enough practice for a large majority of our service, while to adopt them all to isochronous dynamo driving would banish from most of them one very essential good enough feature. Pulley makers and others are as often driven out of business by price as by diameter, and good enough is as necessary in the one particular as in the other.

Good enough will not suffer by exposure to the light. If anyone is doing anything good enough or making anything good enough let as many as possible know it; for there is nothing that all the world is more ready to grasp than good enough. It cannot always grab it in the dark.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(116) R. E. W., Pittsburg, asks: How is the tracing cloth that is used for drafting purposes prepared? A.—We believe the preparation applied to the cloth is some preparation of starch; but the details of the process are, we believe, a trade secret.

(117) B. K. E., Philadelphia, asks: 1. What would be the explosive force of 1 cubic foot of air at 2,400 pounds pressure per square inch, supposing the steel cylinder in which the air is contained were to give way? A.—This would be a case of purely adiabatic expansion. The ratio of initial to final, or atmospheric, pressure would be (2,400 + 15) ÷ 15 = 161, or, reciprocally, 1 ÷ 161 = .00621. For this ratio of absolute pressures the ratio of initial to final volumes would be about .025, or the final volume to the initial volume would be about 40 to 1. Then, for this ratio of volumes, the ratio of the mean effective pressure to the initial absolute pressure would be .0488, and the mean effective pressure during the period of expansion in a cylinder of constant area would be 2,415 × .0488 = 117.85, or, deducting the atmospheric pressure, 117.85 — 15 = 112.85. Supposing the air to be in a cylinder having an area of 1 square foot or 144 square inches, and held by a piston within 1 foot of the length of the cylinder, thus securing the volume and pressure assumed above, then to allow the 1 cubic foot of air to expand to 40 cubic feet, the piston must move 39 feet, and it would be driven that 39 feet with the mean effective pressure given above, 112.85 pounds. The power developed in the operation would be 144 × 112.85 × 39 = 633,765 foot-pounds. The power of gunpowder is usually assumed at 250,000 foot-pounds per pound of powder, so that the power here developed would be about equal to 633,765 ÷ 250,000 = 2.5 pounds of gunpowder. In the explosion of an air tank of the above capacity, and with the air at the assumed pressure, the power as above approximately computed would of course be developed; but the actual practical results are not, after all, quite comparable with those resulting from gunpowder explosions. Although it is not easy to compute the time consumed in occurrences of this character, it is certain that the action of the gunpowder is much the quicker, and therefore more destructive, if the powder is confined. As a matter of fact, when the Mannesman tube tanks, which are now generally used for gases at high pressure, explode there is no flying of pieces, but simply a rupture of the side of the tube, and no other damage results except to bodies actually in contact with the tank or in close proximity. 2. What horse-power would the same cubic foot of compressed air be capable of developing in one minute if used in an air motor, supposing the pressure to be reduced to, say, 100 pounds before using? A.—The mode of treating this question is shown in article entitled "Power of Portable Compressed Air," in this issue.

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Technical Books.

The Buckeye Engine Company of Salem, O., was, we believe, the pioneer in the production of the modern engine catalog, by which we mean a catalog containing real engineering information condensed and put in shape for the great mass of engineers. This company's catalogs have, in fact, been a considerable factor in the technical education of the engineers of this country. We have just received part third of their latest issue, which is devoted to compound engines, and we are glad to see that it fully sustains the character established by previous issues; in fact we know of no publication of equal size from which the average engineer can obtain so much information regarding the theory and practice of compounding, and while small (37 6½ x 9½-inch pages), we feel that we cannot in justice to it give it less than this special notice.

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Death of Prof. A. M. Mayer.

The death of Dr. Alfred Marshall Mayer, for twenty-six years Professor of Physics at the Stevens Institute of Technology, follows very close upon that of Professor De Volson Wood. Professor Mayer was born in Baltimore in 1836. He was educated at St. Mary's College, Baltimore, and at sixteen was in the shop and drafting room of a mechanical engineer, and after two years in that position he was for the next two years a student of analytical chemistry. He was Professor of Physics and Chemistry in the University of Maryland at twenty years of age, and was afterwards in similar positions in several other colleges. In 1871 Professor Mayer accepted the chair of Physics at Stevens Institute, and held that position until February last, when his health finally gave out. Professor Mayer covered a remarkably wide range of interests. His original researches and contributions upon scientific topics were numerous and valuable.

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Personal.

Mr. Geo. L. Roby, of Ashley, Ind., has accepted the position of general superintendent of the Dake Engine Company, Grand Haven, Mich.

Our readers will be glad to know that Mr. Miller returned on the steamship Paris, arriving in New York the morning of the 24th.

Mr. Chas. Davis, president of the Davis & Egan Machine Tool Company, Cincinnati, has returned from a very extended and successful European trip. In recognition of his success in promoting the manufacturing interests of Cincinnati through foreign trade, he was tendered a banquet by the citizens of that city on his return to it.

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George C. Schrieber, of Lincoln, Ill., is making, for the Paris Exposition, a globe which, it is expected, will give a more complete and perfect representation of the earth's surface than ever before shown. As a degree of longitude upon it at the equator will be ½ inch, its diameter will be nearly 60 feet.

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"It is possible that British firms may yet find that the upward tendency of the price of labor is a blessing in disguise, if only they will adopt the same means as their American confrères to cope with it."—The "Electrician," London.

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Talk about Chinese cheap labor! An enterprising firm of Portland, Ore., is going into an extensive manufacture of boxes for the China tea trade. A better box can be made for less money than in China.

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Thanks to the inventor, the engineer and the pushing man of business, Danish, Australian and American butters now meet in competition in the English market.

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We have an inquiry from Sweden for machinery for making horse shoes, and shall be glad to forward such information as our readers can send us.

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The total membership of the American Society of Mechanical Engineers, as represented in the catalog just issued, is 1,800, less 1—1,799.

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We notice that an English engineering firm has been dissolved "by efflux of time."

No Perfect Materials.

If nature, or art, furnished perfect material; if mass, in all respects, was absolutely homogeneous; if steel—the steel of commerce—was what it purports to be, of uniform consistence throughout the beam, or bar, or molded form; if wrought iron was free from slag, sand bars, seams, fire cracks and imperfect welds, and always cold-short, or red-short, or neither; if cast iron never had any blow-holes, never was dense on one side and porous on the other, never shrunk unevenly, so that pulley arms pulled off from the hub in the mold, never went out into the world tense-drawn with internal strains, or weakened with cold shuts; if, in fact, in the leading manufactories of the country, such as the Edgar Thomson Works, flywheels did not occasionally fly apart, wreck the works, and scatter ruin, destruction and death in their path, then material might be tested, not, indeed, in conformity with the assumptions of crude, immature hypotheses, but in accordance with the determined principles of a well-developed theory. Steel could then be tested as steel generically, and iron as iron. But as things are, with their unknowable variations and contrarieties, every piece must be treated specifically; it is a law unto itself, and security demands its individual inspection.—N. P. Gladis, in "Age of Steel."

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"£100 for Drawings.—The advertiser desires to make a steam tractor for his existing four-wheeled carriage, the tractor to have a single wheel driven direct by a double-cylinder engine operated by a boiler of the flashing type. The general arrangement of the tractor, as well as the steering gear, has already been designed, and will be submitted to anyone who will undertake to prepare really reliable working drawings, for which £100 will be paid when the tractor has worked successfully. An interview can be arranged on application to"

The above from "The Engineer," London, shows the way they do things on the other side. The advertiser does not seem to run much risk, and at the same time he may stand a chance of getting some good suggestions.

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A natural gas well recently struck at Baldwinsville, N. Y., is estimated to be blowing away 5,000,000 cubic feet of gas per day. That is 3,472 cubic feet per minute. A foot of natural gas develops 1,100 units of heat, so that there are $3,472 \times 1,100 = 3,819,200$ heat units, or $3,819,200 \times 772 = 2,948,422,400$ foot-pounds. It is fortunate for us that every pound of coal has to be dug or hoisted. If a new coal mine began blowing away 2,000 or 3,000 tons a day, which would be about the thermic equivalent of the above, we would be poorer than we are now.

The present valuation of the ships of the British Navy is $470,000,000. The first cost of the fleet which led to the downfall of Napoleon was $50,000,000.

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The Bazin roller boat has, after several trials and alterations, attained a speed of 6 knots; 37 knots were talked about.

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Commercial Review.

NEW YORK, Saturday Evening, July 24.

THE FAVORABLE SURROUNDINGS OF TRADE.

While in volume and in prices the business of July, 1897, might be little flattered by a comparison with that of July, 1896, the circumstances which tend to influence its prospects present a wonderfully bright contrast with those of a year ago. Instead of an outlook over months of dullness which must intervene before election, to deaden fall trade, there is now only the natural quietude of a few remaining weeks of summer to separate us from the time when the market will be free to assert its elasticity.

While there is one unfriendly but, it may be hoped, only temporary factor in the market, namely, the strike of the bituminous coal miners, the benignant influences are numerous and potent. Rumors of war are scarcely audible; the tariff uncertainty has terminated; crops are abundant, and thus in the West, where depression has been the deepest, the new vigor of trade is likely to be felt early. Lastly may be mentioned the discovery of the Klondyke gold fields. With regard to these it is too early to form definite conclusions; yet in estimating their possible significance, suggests itself a late remark of Henry M. Stanley, that the most important event of the Victorian age, in his opinion, has been the opening of the South African gold fields, which have furnished the means of attaining the great material prosperity which that epoch has seen.

MILL AND MACHINISTS' SUPPLIES.

It is almost inevitable that July and August should witness a shrinkage in these lines of trade, and indeed the total volume of business now transacted is not heavy. Yet a more business-like attitude on the part of buyers, and a more hopeful feeling on the part of sellers are felt in so many quarters as to afford a comfortable standing-room for those who look for an improvement in the fall.

About the first of this month occurred the subsidiary stock-taking period of the year. The practice is quite general among mills and factories to close down for a few days at this season. In a dull year such as the present, many of those who under other circumstances would reopen at the end of a week, remain closed for two weeks or longer. These matters have some influence upon the supply trade. In many cases orders might be expected to be delayed until the period is over. Power-transmitting machinery, it is said, and no doubt this is true of other lines, is rather helped than otherwise, by this short suspension, because it can conveniently be utilized for shop improvements.

In regard to prices, a decline in cold-rolled steel shafting, owing to a dissolution of the combination, has already been noticed by those who have followed our weekly quotations. On July 21st took effect an increase in the discounts on brass and bronze, sheets, rod and wire, to 45 per cent., and on brazed tube, molding, angel, channel and door rail, to 47½ per cent.

This remark is made by one party: "My attention has recently been called to the extremely low figure at which wood screws are obtainable. In all lines of supplies the manufacturers and their agents are in the habit of cutting prices, and thus injuring the jobbers. They are after the dollars, and therefore there seems to be no prospect of an end to this practice."

Says a prominent seller of power transmitting machinery: "We are approaching a dull season of the year for this line, but hitherto our trade has improved. Small orders have been numerous. Among the contracts upon which we are now figuring one is the out-door transmission of 200 horse-power of water power 2,000 feet, for factory purposes." Another leading power transmitting machinery house reports that while sales have not increased, there are a great many inquiries in the field.

Among recent contracts for power transmitting machinery may be mentioned those for the equipment of the Armour grain elevator in Chicago and for a grain elevator in Buffalo. They were taken by the Dodge Manufacturing Company. An export firm is reported to have bought, this week, $16,000 worth of power transmitting machinery for shipment to Japan.

A dealer in emery and emery wheels says: "Trade with us is quiet, but it usually is in July and August. At least it is no worse than last year. The demand for emery wheels is about the same as it has been. For ground emery there is a little better outlook, owing to an improved disposition to buy on the part of the glass bevelers."

AN OPPORTUNITY FOR ELECTRIC RAILWAY MACHINERY.

An electric railroad is projected, to run from Lake Geneva, Wis., to Streator, Ill., crossing nearly every important railroad that runs northwest from Chicago, and utilizing the Chicago River to furnish a portion of its power. It has been stated that some contracts for its construction may be advertised for in a month from the present time, though possibly not until next year.

CINCINNATI REPORT.

During the past few years of depression Cincinnati has held its own fairly well as compared with other industrial centers, in the manufacture of engines.

machine tools, and many other kinds of machinery. Since the political contest of 1896 that city has shared somewhat in the public hope of renewed prosperity, and if the results have not as yet proved satisfactory, expectations for the end of this year afford some encouragement. A correspondent of the "American Machinist" has interrogated a number of leading manufacturers as to the business situation from their respective standpoints, especially comparing the half year just closed with the first half of last year. A number of reports thus obtained are given below. Most of them agree in the experience that domestic trade has been quiet, but export orders good.

The Cincinnati Milling Machine Company reports an improvement for the first six months of this year as compared with the first six months of last. It has come chiefly from export trade, in furtherance of which Mr. F. A. Geier, the energetic secretary of the company, last year spent several months in travel.

The Davis & Egan Machine Tool Company report improvement as compared with last year, principally in exports, which continue abundant. The June business of this year has exceeded that of any month since 1892. A $20,000 order from London and one for nearly $10,000 from Paris have been included in the recent sales.

The Cincinnati Screw and Tap Company, although having had a fair measure of business, do not feel that it has been larger than that of the first half of last year. Their field has, however, been limited to this country, for the many little peculiarities of their line of manufactures constitute a barrier to placing them upon the foreign market.

The Bickford Drill and Tool Company have found an improvement in this year's business, only a small portion of which has been domestic.

Dietz, Schumacher & Boye have done a much larger business during the first half of this year than in the first half of last year. The improvement has largely been due to increased exports. For more than two months Mr. Boye, a member of the firm, has been in Europe, and when last heard from was in Germany. His efforts have resulted in bringing in a good number of orders.

The Lunkenheimer Company, manufacturers of valves, etc., experienced an increased business during the first six months of this year, as compared with the corresponding period in 1896. Trade has been good at home and abroad.

The J. A. Fay & Egan Company report some increase for the periods of time compared, due almost or quite entirely to the foreign market, home trade having been light.

The Lodge & Shipley Machine Tool Company close an improved half-year, as compared with a year ago. Home trade as well as exports have been of a good volume. During the present year Mr. Lodge spent several weeks abroad, orders for some hundred machines being the result.

A comparison of the two half-yearly periods, shows to the Bradford Mill Company an improved business, most of it being that which has come from foreign countries.

R. K. Le Blond, lathe manufacturer, while having done a very fair amount of business to July 1st, does not discover any especial increase over last year. The orders received have been quite largely from abroad.

William E. Gang & Co., manufacturers of radial drills, although they have received a tolerable volume of trade, do not see that it is better than that of last year; but they have not given any attention to the foreign market, so that the

(Continued on page 30.)

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Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Gear and milling cutters, adjust. reamers, counterbars and tools, vert. millers, drill pr., cutter and surf. grind., shears. R. M. Clough, New Haven, Ct.

Cost of Manufacturing—Experienced manager will establish system of costs, giving exact account of every detail. Charge based on saving effected. Correspondence solicited. Geo. C. Thomas, 99 Nassau Street, New York, Room 212.

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Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday Morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Exp. mch. draftsman. Box 100, Am. Machinist.

By exp. machinist, toolmaker; comp. and reliable; handled help 11 years; hard work'r. Box 89, Am. Mach.

A good planer or lathe hand, used to micrometer msments., 10 yrs. exp., wants pos. 103, Am. Mach.

Grad. in mech. eng., 3 yrs. exp. eng. work, wishes pos. with steam eng. concern. Box 110, Am. Mach.

Machine designer wants position; tech. and bus. college grad.; 7 years exp. Box 114, Am. Machinist.

Mech. draftsman, graduate, Swede, 8 yrs. exp. this country, wants pos.; steam engs., ry. works, gen. mchy.; mod. terms; best ref. Box 111, Am. Mach.

Foundry foreman open to engagement; engine, mach., locomotive or architectural work; green and dry sand or loam; iron, brass or semi-steel. For particulars and ref. address Box 113, Am. Machinist.

First class brass foundry foreman wants position; mixes metals from old and new stock; years of experience with men, boys and girls, and working machines; first class ref. Box 115, Am. Machinist.

Help Wanted.

Wanted—Two first-class all-around machinists. Work will probably last through the Winter, at least. Gifford Bros., Hudson, N. Y.

Wanted—Superintendent for a large machine tool works; one thoroughly experienced in all details of the business. Address Box 108, Am. Mach.

Wanted, by German tool works of high reputation, foreman for erecting shop; must be competent to introduce American system of building machines in quantities and interchangeable parts. A1 machine hand, for circular grinding in all its branches. A1 lathe hand, competent to take charge of departm'nt; must be able to turn work cheaply and quickly. Those speaking German preferred. Address, stating salary, references, etc., Box 99, Am. Machinist.

Wanted—A first-class foreman for machine shop in growing business in good class machine tools in a pleasant locality. Must be able to manage men to best advantage up to modern method and able to get out work expeditiously and economically, of sober and steady habits. Address, stating age, wages expected with view of increase as qualifications are shown and business increases, married or single and references to Box, 109, American Machinist.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S. M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Patents, Machinery Designed, Drawings. Henry F. Noyes, 56 Liberty Street, New York.

The Dutton Wet Twist Drill Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

Wanted—Machinery for polishing flat and round wire in lengths. Address, Box 112, Amer. Mach.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Model Locomotives—Complete castings, latest N. Y. Cen. standard, up to date; 4c. in stamps for cat. alog. G. H. Olney, 163 Herkimer St., Brooklyn, N. Y.

Lathes, planers, drills, milling machines, vises, also brass working machinery second-hand; must be modern, cheap and in first-class condition. C. C. Wormer Machinery Co., Detroit, Mich.

A business house of standing, with office and salesrooms in business center New York City, would represent first class manufacturing concern. Address Metal, care American Machinist.

For Rent—A machine shop in connection with our factory; traveling crane and all conveniences; power, heat and light supplied; railroad siding; rent may be paid in work. Address Delaware Hard Fibre Co., Wilmington, Del.

Wanted Capital, $10,000—A one-half interest in an established machine tool company is offered a practical man having the executive ability to conduct the business. Strictly modern shop and equipment with ample orders. Address Box 49, American Machinist.

A machine shop, with modern equipment, heavy and light machinery, cranes of 20 tons capacity and 10,000 square feet of unoccupied floor space, would contract to manufacture any kind of machinery. Parties already having machinery built under contract might do well to write us for estimates. Box 62, American Machinist.

Mail Your Catalogue

to my address and I will write you describing my scheme to increase your profits. It's no experiment, and I only charge for what I accomplish in actual results.

GEORGE L. ROBY, Ashley, Ind.

BEVEL GEARS

Cut Theoretically Correct.
Special facilities for cutting worm wheels.

HUGO BILGRAM,
Machinist,
440 N. 12th St., Phila., Pa.

(Continued from page 35.)

orders they have executed have been derived from this country.

Quotations.

NEW YORK, Monday, July 26.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 00 @ $12 50
No. 2 foundry, Northern	10 50 @ 11 25
No. 2 plain, Northern	10 25 @ 11 00
Gray forge, Northern	9 75 @ 10 25
No. 1 foundry, Southern	10 50 @ 10 75
No. 2 foundry, Southern	10 00 @ 10 25
No. 3 foundry, Southern	9 75 @ 10 00
No. 1 soft, Southern	10 75 @ 11 00
No. 2 soft, Southern	— @ 10 50
Foundry forge, or No. 4, South'n	9 50 @ 9 75

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.00 @ 1.05c.; refined, 1.10 @ 1.15c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.35 @ 1.45c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some brands perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel — Ordinary brands, from store, in small lots, 1.50c.

Cold Rolled Steel Shafting—Base size, in small lots, from store, 2¼c.

Copper—Carloads lots, Lake Superior ingot, 11 @ 11⅛c.; electrolytic, 11c.; casting copper, 10¾c.

Pig Lead—The new tariff law has stiffened the price, which is now 3.90c., in car loads, f. o. b.

Pig Tin—For 5 and 10-ton lots, 13.85 @ 13.90c., f. o. b.

Spelter—Carload lots, New York delivery, 4.30c., f. o. b.

Antimony—Higher under the new tariff. Of the two leading brands, 8c. has been asked for Cookson's and 7½c. for Hallett's, but 7½c. and 7¼c. respectively are probably fairer quotations.

Lard Oil—Prime city, present make, commercial quality, in wholesale lots, 36 @ 37c.

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Manufactures.

At Lehighton, Pa., a new silk mill will be erected.

At Griffin, Ga., the J. D. Boyd Mfg. Co. are to erect a new mill.

At Pittsburg, Pa., D. O. Cunningham is to build a glass factory.

At Randolph, Mass., the Burt factory is having an addition erected.

At Paterson, N. J., the Paterson Novelty Co. has been organized.

At Dolgeville, N. Y., Mr. Charles Millett is erecting a machine shop.

The Bonanza mine near Walkerville, Mont., is about to be restarted.

At Baltimore, Md., the Baltimore Tin Plate Co. has been incorporated.

The Illinois Steel Co. will rebuild and newly equip all its mills at Bay View.

At Hinsdale, Vt., J. R. Holman is to make an addition to his machine shop.

At Dover, Del., Jacob Levy will soon commence the erection of a distillery.

At Virginia City, Va., a new stamp mill is to be erected on the Bradley mine.

Mr R. G. Ware is intending to reconstruct the ginning mill at Providence, Fla.

The town of Madison, N. J., contemplates the placing of an additional boiler.

Harrison Bros. & Co., Philadelphia, Pa., are to build two additons to their plant.

At Cumberland, Md., S. S. Marvin is contemplating the erection of a factory.

The Union Woolen Mill Co., of Union, Ore., are going to install new machinery.

At Buffalo, N. Y., the Larkin Soap Company is erecting a boiler-house at its works.

Jos. W. Wilson, of Salt Lake City, Utah, contemplates the erection of a new mill.

Kimmel & Mossop, of Williamstown, Pa., are erecting an addition to their factory.

At Niles, O., the Coleman-Shields Co. are making some improvements to their plant.

Drending Bros., of Philadelphia, Pa., contemplate the erection of a factory building.

(Continued on page 37.)

VAN NORMAN "DUPLEX"

Milling machine allows cutter spindle to be set horizontal, vertical OR ANY ANGLE BETWEEN instantly. It saves fixtures and cutters on general work.
Ideal tool room machine.

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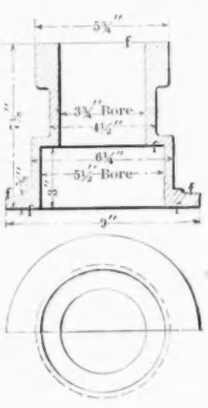

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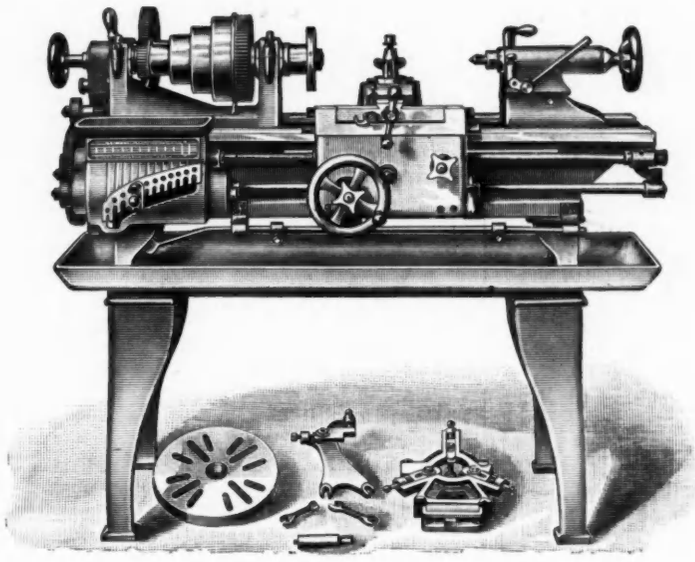

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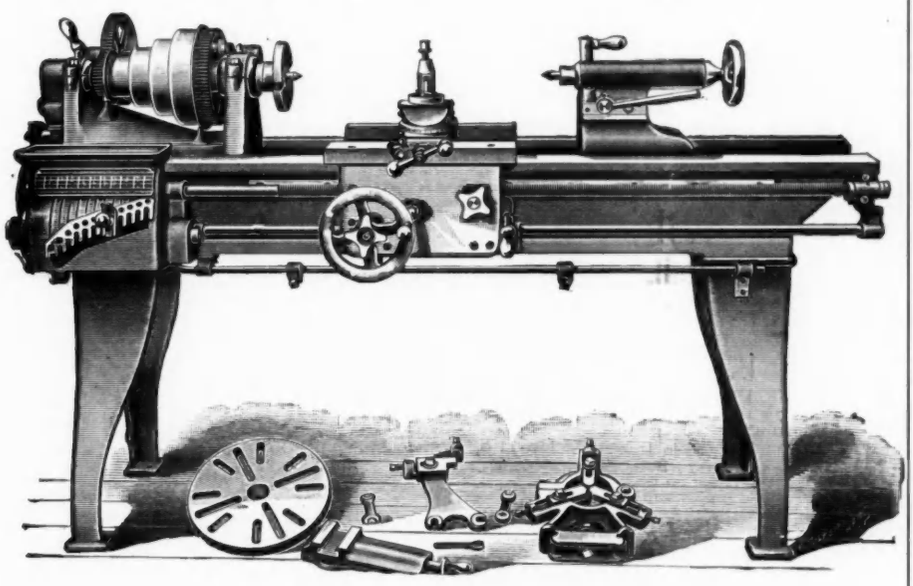
is fitted with drawing-in sleeve and American Watch Tool Co's standard chuck, used in making small taps, reamers, etc. Work finished first and cut from bar afterwards. No centering required. See carriage reverse lever by right-hand side of apron; no reaching for countershaft shipper required.



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Eugen Soller, Basel, Switzerland.

(Continued from page 36.)

The Burnham & Morrill Company is building an addition to its factory at Harrison, Me.

At Leesburg, Fla., the work of building the Plant System shops is progressing nicely.

C. D. Boss & Son, of New London, Conn., contemplate the enlargement of their plant.

The flouring mill of S. H. Carnahan, at Worthington, Ind., has been destroyed by fire.

The planing mill of John A. Schumacher & Co., Indianapolis, was recently destroyed by fire.

The Gilbert Manufacturing Company, of Bainbridge, N. Y., was recently destroyed by fire.

At Ceresco, Neb., the grain elevator belonging to the Roberts Co. has been destroyed by fire.

The Sterling Mills, of Lowell, Mass., have let the contract for the erection of a new mill.

The Missouri Pacific Railroad will erect an additional building at Sedalia, Mo., at an early date.

The Hercules Paper Bag Company, of Reading, Pa., are to erect an addition to their plant.

The Monohansett Manufacturing Company, of Putnam, Conn., is about to enlarge its plant.

At Braddock, Pa., the Carnegie Steel Company have commenced the erection of a boiler plant.

At Plainfield, N. J., the Potter Press Works have begun operations on an addition to the foundry.

At Ogden, Utah, the Checkmate Mining Co. has been chartered. John D. Carnahan is president.

At St. Lawrence, Que., the Portland Cement Co. has been established. Roderick C. Carter is interested.

George Oldham's Sons, Frankford, Philadelphia, are having additions made to their machine shop.

Mead, Mason & Co., of Goffe's Falls, N. H., are contemplating the erection of a new mill at an early date.

The plant of the Whitman & Barnes Company, of Syracuse, N. Y., is to be removed to West Pullman, Ill.

At Berlin, N. H., the Berlin Mills were recently destroyed, and it is now learned that they will be rebuilt.

Levy Bros., of New York, are to purchase a factory at Middletown, Conn., and start a silk ribbon weaving industry.

The Souderton Improvement Co., of Souderton, Pa., will erect a building to be used for the manufacture of cigars.

At Columbiana, O., Sol. Koch intends to use a building he recently purchased for the manufacture of washing powder.

At High Park, near Cripple Creek, Colo., a new stamp mill is being erected. Mr. Ben I. Brooks will be in charge.

The old Creeson woolen mill, at Norriston, Pa., is soon to be occupied as a foundry by a firm hailing from Philadelphia.

At Pueblo, Colo., the Tony Ore Reduction Co. has been incorporated by Frank Pryor, Chas. Henkel, John Morton, etc.

The buildings of the Black Iron mine at Red Cliff, Col., have been destroyed by fire, much of the machinery being damaged.

The Century Hammock Co., of Worcester, Mass., are contemplating the movement of their shops to a point nearer Boston.

The plant of the Akron (O.) Iron & Steel Company, which was recently destroyed by fire, will be rebuilt at an early date.

At Cincinnati, O., Messrs. Ball & Taylor,

architects, have been commissioned to find sites for three manufacturing plants.

The Naples Mining Company, of Santa Barbara, Cal., has been incorporated by H. W. Mazzal, C. W. Hayward, H. C. Booth, etc.

At Cincinnati, O., a six-story manufacturing building will be commenced for the Bodmann estate, of which Mr. L. Reakirt is manager.

The EmpireMachine Co., of New York City, has been incorporated by Wm. C. Doscher, A. L. Foss and F. E. Atkinson, of New York City.

At Waterville, Me., the Newport Woolen Co., is to make additions to their mill. This will make an opening for about 300 extra hands.

The Kreuger Mountain Gold Mining Co. has been incorporated. Thos. Stacey, Chas. Johnston, I. J. Blair, of Spokane, Wash., are the incorporators.

The Union Iron Works of Buffalo, N. Y., are to erect a new blast furnace. The new plant, when completed, is expected to employ about 250 men.

The factory of Rastetter & Son, at Fort Wayne, Ind., will be enlarged at an early date, and to this end they have purchased a site on Garden street.

The Savanoid Manufacturing Company, of New York City, has been incorporated. Directors: Herbert E. Plass, James V. Falvey and Francis W. Elder, all of New York.

The National Oil Company, of Seguin, Tex., are making rapid progress with their new mill. The mill, when erected, will be fitted up with the most improved machinery.

The Oklohoma Cement & Plaster Co. has been incorporated by Lewis H. Rogers and Ernest J. Bagnall, of Cleveland, O., and Hewitt Boice, C. A. Oakes & Willis M. Burhans, of Kingston, N. Y.

The Grant Ball Co., of Cleveland, O., has been incorporated with a capital of $100,000 to engage in the manufacture of ball bearings, cups, cones, etc. Senator Jas. R. Garfield, H. A. Garfield, R. H. Grant, Frank J. Pool & Mortimer G. Fox are the incorporators.

The Vulcan Foundry Company, of Pawtucket, R. I., has been organized, and has purchased property, where it is intended to erect a foundry at an early date. The following are the directors: Darius L. Goff, Gardiner C. Sims, William H. Haskell, William P. Dempsey, etc.

At Putnam, Conn., the Putnam Manufacturing Company will soon commence the erection of an addition to their plant, and when completed the most improved style of cotton mill machinery will be installed. The cost of the whole work, it is estimated, will be about $250,000.

The Saratoga Gas, Electric Light & Power Company, of Saratoga, N. Y., are rebuilding and rearranging their gas plant, and have let the contract for the steel work connected with the generator house roof and the roof over their cold storage building to the Berlin Iron Bridge Company, of East Berlin, Conn.

The Ion Manufacturing Company of New York City, to manufacture vehicles, boats, elevators, motors and electrical, gas and pneumatic machines, has been incorporated with a capital of $250,000. The directors are Thomas W. Horn, of Toronto, Canada; Owen T. Bugg, Walter R. Clayton, of New York City, and others.

The Union Car Company, of Depew, N. Y., has leased the shops of the Schuylkill Navigation Company, Reading, Pa., for several years. It is the intention of the company to erect a foundry on the most improved style for the manufacture of car wheels. The firm will be known as the Reading Car Wheel Company, and Mr. R. E. Coleman is to be superintendent.

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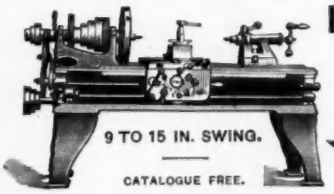

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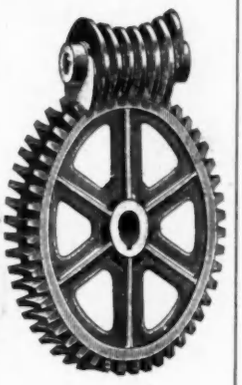

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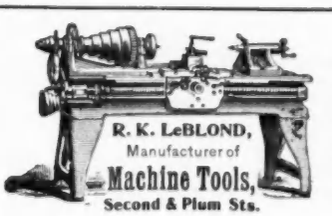

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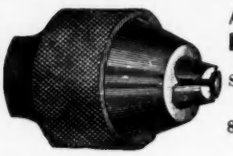

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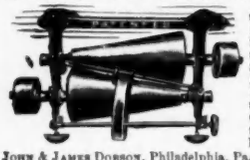

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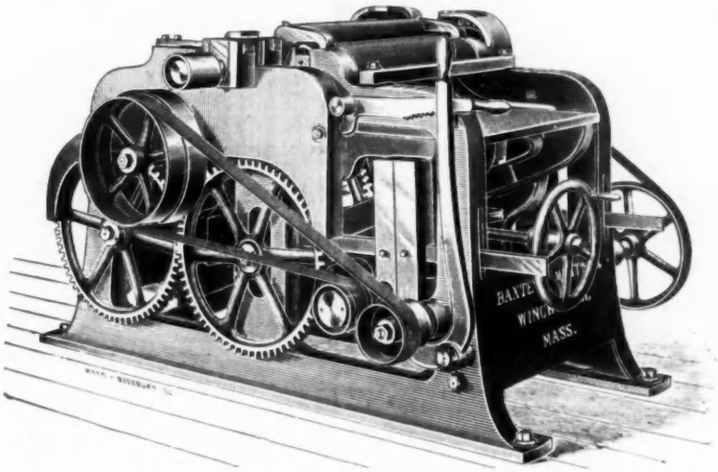

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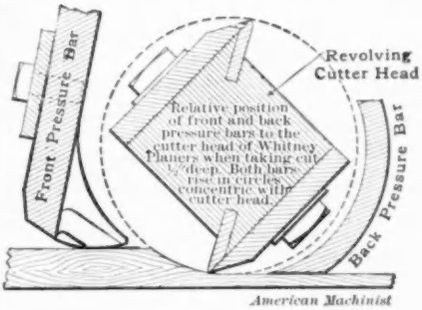
Front Pressure Bar
Revolving Cutter Head
Relative position of front and back pressure bars to the cutter head of Whitney Planers when taking cut ⅛" deep. Both bars rise in circles concentric with cutter head.
Back Pressure Bar
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•• P4 ••

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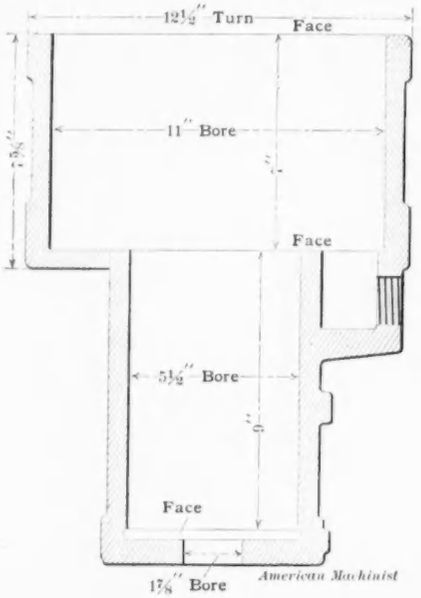

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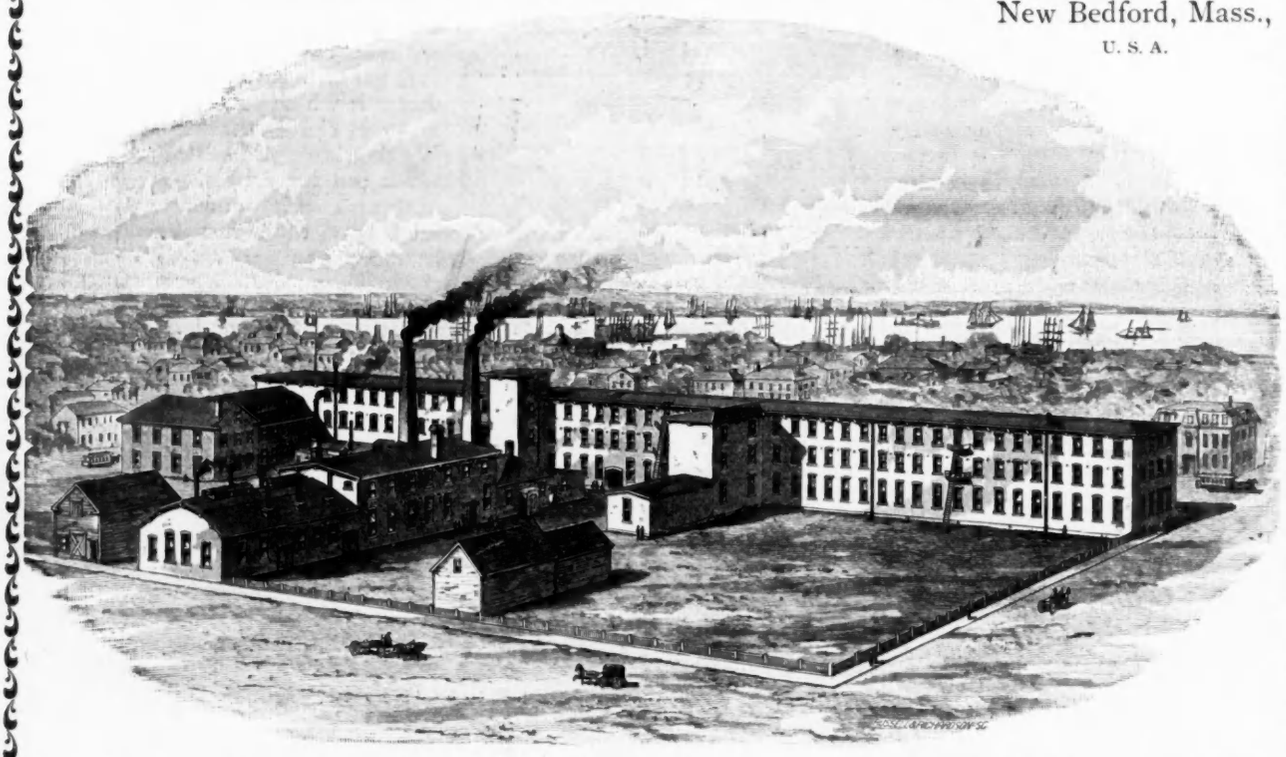

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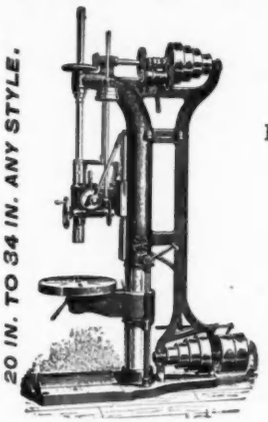

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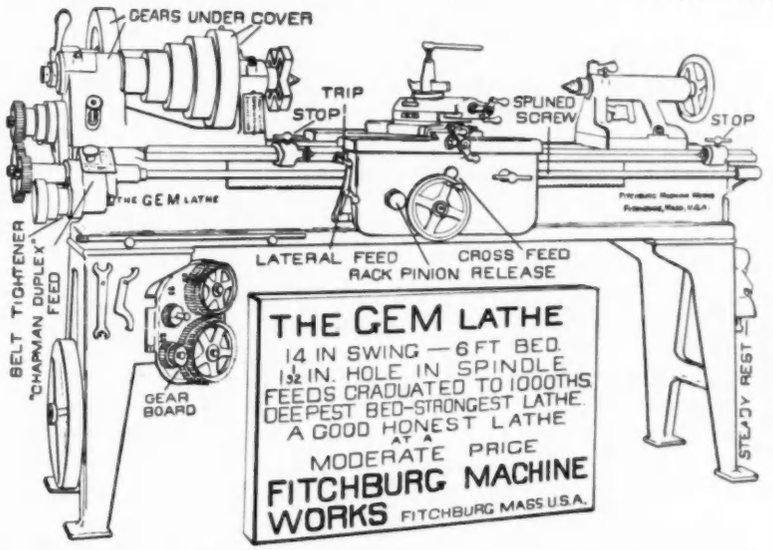

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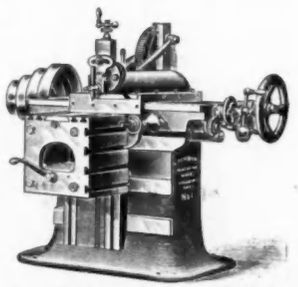

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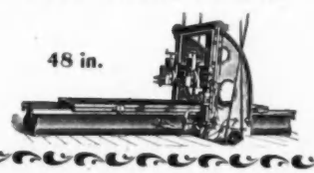

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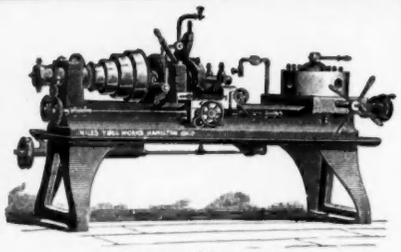

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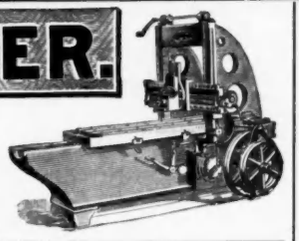

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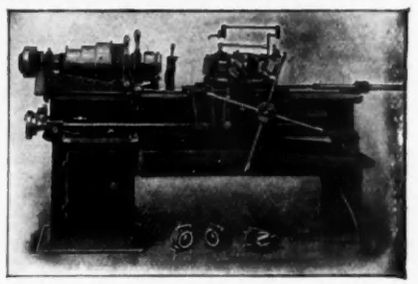

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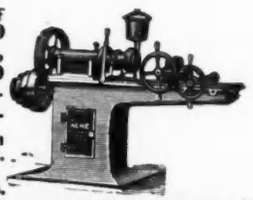

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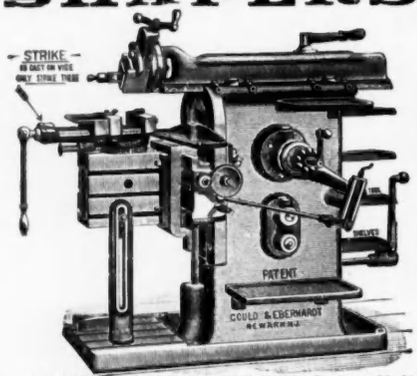

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